Red Meat from Pasture: Sustainable Livelihoods for Small Mixed Farmers in China's Yunnan Province

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Abstract

China's pattern of food consumption is changing. The demand for high quality red meat is rapidly increasing, especially in the more affluent coastal regions. The pastoral livestock farmers in Southwest China have low and declining incomes, and operate in a highly uncertain environment. This environmental uncertainty is derived from the seasonal climate, land tenure policies, and a dealer-dominated supply chain in which information is scarce, ambiguous, and untimely. The researcher spent two years in China's Yunnan Province working on a pastoral development project. During this assignment, the researcher undertook a case study of the small, mixed livestock and cropping farmers involved in the project, together with an evaluation of alternative strategies for pastoral development and enhancing livestock production. The case study also involved an overview of agricultural extension and the red meat supply chain in the study area. The current farm production systems are environmentally, financially and socially unsustainable. Farm output is low and achieved inefficiently at considerable cost to future productive potential. Farmers are not investing in farm improvements because they lack confidence in their ability to generate a return from such investments. Confidence is low because farmers do not trust other supply chain participants, and they perceive a low level of control over the operating environment. This is resulting in a vicious cycle of unsustainability. There are numerous market opportunities emerging due to changes food consumption. Farmers have three broad strategic options for taking advantage of these opportunities: invest in technologies to raise output and quality, further process to add value and increase consumer acceptance of red meat and co-operate within the supply chain. The technologies extended as part of the development project were demonstrated to yield significant benefits in terms of production and profit. However, adoption has been low because many of the technologies did not consider local constraints, extension has not widely occurred and uncertainty in the operating environment did not encourage investment. For farmers to be able to successfully implement these strategies farmers need to be empowered and a more enabling environment created. This empowerment involves changing farmers' perception of locus of control, sharing control and supply chain participants learning about each other. Co-operation between farmers and the rest of the supply chain should provide benefits along the whole chain. A model for co-operative and sustainable development is proposed and limitations of this model are discussed.

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Abbreviations

ADB	Asian Development Bank
AHB	Animal Husbandry Bureau of Yunnan Province
CIDA	Canadian International Development Agency
FAO	Food and Agriculture Organisation of the United Nations
GGERI	Gansu Grassland Ecological Research Institute
NBS	National Bureau of Statistics, Peoples' Republic of China
OECD	Organisation for Economic Co-operation and Development
UNDP	United Nations Development Programme

Units

Billion	1×10^9
DM	dry matter
Million	1×10^6
Mu, 1 mu (亩)	1/15 ha
s.u.	stock unit, one stock unit = one 55 kg ewe raising 1.1 lambs to weaning, equivalent to 550 kg DM/year.

Place names and work units mentioned in text with Chinese translation

Animal Husbandry Bureau of Yunnan Province 云南省畜牧局

Bei Da Ying Village 云南省寻甸回族彝族自治区河口乡北大营村

Gansu Grassland Ecological Research Institute 甘肃省草原生态研究所

Lang Mu Mountain 云南省曲靖市麒麟区沿江乡郎目山

Qujing City 云南省曲靖市

Qujing Prefecture 云南省曲靖地区

Xun Dian County 云南省寻甸回族彝族自治区

Yun-Gui Plateau Sustainable Pasture Technology Research and Development Project 国家“九五”科技攻关“云贵高原草地持续发展技术研究专题”

Yunnan Province Sheep Breeding Farm 云南省种羊场

Exchange Rates and Currencies

USD	United States dollar
NZD	New Zealand dollar
RMB	Chinese yuan, Renminbi
USD : RMB	1 : 8.27
NZD : RMB	approximately 1 : 4.5 during the study period

1 Introduction

1.1 Poverty in China

Poverty in China is predominantly found in rural regions although it is becoming increasingly significant in urban areas as urban unemployment rises (ADB, 2000). There is significant poverty in China, although estimates with respect to this level of poverty are conflicting (Table 1.1).

Table 1.1: Official and International estimates of poverty in China. Numbers in brackets indicate percentage of population.

Year	State Bureau of Statistics[1]	International Estimates		
		$1US/day	$1US/day[2] (1985 purchasing parity)	$2US/day[2] (1985 purchasing parity)
1997	50 m (5.4%)	124 m (13.5%)	-	-
2000	27 m (3.1%)	-	230 m (18.5%)	670 m (53.7%)

[1] The official poverty line is based on annual income of 635 RMB per capita, and is only measured in rural areas. [2] World Bank estimates based on consumption norms at 1985 purchasing parity. Sources: UNDP (1999b); ADB (2000). The official exchange rate since 1996 is $1 US = 8.29 RMB.

There are clearly a considerable number of rural and urban people living with limited opportunities. People with such low incomes are often unable to cope with stresses and shocks, maintain or enhance their capabilities and assets, or provide sustainable livelihood opportunities for the next generation (Chambers and Conway, 1992).

Poverty is more prevalent in the western provinces (ADB, 2000). Hence, the focus of the Central Government's Tenth Five Year Plan is on developing these provinces, resulting in large amounts of finance being channelled there.

1.2 Feeding China and the demand for red meat

There are three factors likely to contribute to the expected increase in demand for meat products in China:

(i) Increasing urban affluence will raise demand for high quality meat products that are healthy, convenient, nutritious and produced using animal and environment friendly methods (Rae, 1995; van Gelder et al., 1998; ClearThinking.com, 2000);

(ii) Continued economic growth will see disposable incomes increase further, raising the demand for protein rich food products (Rae, 1995; World Bank, 1997b; van Gelder et al., 1998); and

(iii) Continued population growth will multiply the affects of economic growth (Cai et al., 1998; Heilig, 1999).

Economic development in China is likely to cause the large rural population to migrate to cities in search of work, as farming modernises and they become surplus to the needs of agriculture. Agricultural productivity will need to increase and a food industry will need to be established (Heilig, 1999). Current production techniques are unlikely to supply meat of the required quality or volume in the future. Grain feeding to increase the livestock slaughter rate may be possible, but there are concerns about China's ability to source sufficient grain to meet future demands (e.g., Brown, 1995; World Bank, 1997b). Thus, new and more efficient means of producing meat need to be adopted.

In the Southwest region, the potential for improvement is considerable. Key changes needed to help realise this potential are the introduction of improved cattle breeds and pastures, and the management of these pastures (Zhang et al., 1997; Ren and Jiang, 1999)

1.3 Pastoral livestock systems

New Zealand is widely recognised as having the lowest cost livestock production systems in the world (Chu, 1997; Connor et al., 1998). These systems are designed around New Zealand's comparable advantages of relatively abundant land, temperate climate with adequate rainfall and sunlight, and a considerable knowledge base. The driver of New Zealand's pastoral systems is the legume, white clover (*Trifolium repens*), capable of supplying nitrogen via nutrient cycles to the other pasture species. Phosphorus fertilisers are critical to ensuring productive white clover-based pastures. In New Zealand, animal feed demand is strategically matched to the seasonal growth pattern of pasture. Controlled grazing, both in terms of feed allocation and using complementary livestock classes to optimise pasture utilisation, is central to the sustainability of New Zealand pastoral livestock farms.

There have been frequent suggestions that the climate, terrain and other conditions of Southwest China are very similar to those found in New Zealand. However, there are some significant differences as described by Chu (1997): New Zealand's rainfall is more evenly distributed throughout the year, summer is drier, and winter and spring are wetter than in China. The integration of different land classes is more difficult in China because of the demand for fertile flats to grow crops for human consumption. A further difference is that Chinese farmers often farm to survive while in New Zealand farming is a business. All of these differences influence the strategies employed in pastoral livestock systems. The key similarities between New Zealand and China are the need for both low cost and sustainable farm systems (Chu, 1997).

1.4 Extension and development

A critical component of any development programme is participant learning (Stiglitz, 1998). Learning involves capacity building and the transfer of technology. Capacity refers to the ability to perform certain functions and the ability to exploit opportunities (Chambers and Conway, 1992). There are many models of technology transfer (Reid, 1996b), each of which is appropriate in different situations. Thus, it is important to understand the circumstances of the targeted people and be able to determine the most suitable extension method(s). Technology transfer and participatory technology development are central to capacity building, and provide learning opportunities.

Sustainable development also requires opportunities (e.g., market access, requiring reduced bureaucracy and improved roads) to be available to poor people.

1.5 Supply chain management

The international development community now recognises that merely helping farmers to boost productivity often does not result in a corresponding rise in their income (World Bank, 2000). There is a need to provide opportunities beyond the farm-gate through infrastructural development, credit, and improved markets, in combination with production assistance (Swanson et al., 1984, cited in Campbell and Barker, 1997). A useful framework for analysing 'external opportunities' is supply chain management theory.

A supply chain is the term used to describe the concept of all participants in the transformation of raw materials into a final good purchased by consumers. Supply chains exist everywhere, but managed supply chains are far less common. Supply chain management is becoming increasingly popular in manufacturing and processing industries (Lewis, 1990; Anderson et al., 1997), and is now beginning to gain greater acceptance in the agriculture and food sectors (Fearne, 1998). The spread of supply chain management can be attributable to firms recognising that in the delivery of goods and services to consumers, they alone do not create value, but rather that each member of the entire supply chain adds value. Through the establishment of vertical linkages with suppliers and customers, firms have been able to improve efficiency and control costs, attain a more appropriate risk-return profile, and better match customer and consumer demands (O'Keefe, 1998b; Spekman et al., 1998). Central to supply chain management is the flow of information on what are final consumer requirements, the product specifications at each stage within the supply chain, and how those specifications can be met (Mohr and Spekman, 1994).

Such an approach is necessary for the successful development of China's beef (Zhang et al., 1997) and other pastoral livestock industries.

1.6 Research project

Poverty in China is a significant problem, especially in rural regions, and farmer incomes are low. However, the demand for red meat is increasing, especially the demand for high quality red meat, as urban consumers become more affluent. This suggests there is an opportunity for farmers, particularly pastoral farmers, to increase red meat output and generate higher incomes. Rural households raising beef cattle have higher incomes compared to similar households not producing beef (Zhang et al., 1997). New Zealand pastoral livestock farming principles may provide guidance on how to increase productivity. However, the need to provide assistance beyond the farm such as credit, institutional support, and functioning markets must not be neglected.

The research question is therefore:

"What are the opportunities for, and constraints to, increasing the level of net farm income of farmers through pasture-based red meat production in Qujing Prefecture, Yunnan Province, China?"

Consistent with the production focus of the research, the following four objectives were established to guide the research:

(i) To describe the current red meat supply chain in Yunnan.

(ii) To investigate and evaluate ways of increasing pasture-based red meat productivity using proven New Zealand pastoral livestock system technology.

(iii) To identify internal and external factors influencing technology uptake at the farm level.

(iv) To identify external factors affecting the increase in net farm income resulting from increased red meat productivity, based on supply chain management, development, and extension theory.

This research was completed during a two-year assignment as a United Nations Volunteer working as a pastoral livestock systems specialist on a National Five Year Plan pastoral development project in China's Yunnan Province. The assignment involved working with pastoral farmers who each operated approximately 100 mu[1] of grassland plus some cropping area (up to 15 mu), with the aim being to raise their farm output. New Zealand pastoral livestock system technologies were seen to be central to achieving this goal by the project designers and management. These farmers, who produce wool, sheep meat and beef, provide the context for the study presented.

The position of employment meant that it was not possible to freely collect information as might have been possible in a research posting. However, information with respect to industry co-ordination and opportunities for increased management of the supply chain may still not have been readily available.

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[1] Mu is the Chinese unit of area. 1 mu = 1/15 hectare.

1.7 Thesis outline

The literature review spans four chapters because of the diverse subject areas covered. **Chapter Two** discusses the operating environments in which farms exist; family and subsistence farms; farm systems, their components and the factors influencing farm performance; and strategies for improving farm systems and increasing control over farm performance.

Chapter Three reviews the theory of adoption of innovations, including why farmers do and do not adopt technology, with emphasis on the factors driving adoption decisions. The various extension practices are also described and analysed with respect to their relevance to extending pastoral livestock farming practices in Yunnan Province.

In **Chapter Four**, the theory of the firm and industry co-ordination is reviewed and the more recent developments in co-ordination of supply chains are discussed with particular emphasis on the role of supply chain management in agriculture and the benefits that can accrue from such an approach. The establishment and maintenance of managed supply chains or value chains is also discussed. The content in this chapter is not strictly a component of the programme of study undertaken, but is included here because of its relevance to discussion of the implications of the study.

Chapter Five, on development, brings the previous three chapters together and puts them into context with the problem statement. Past approaches to development are reviewed, the new focus of development programmes is discussed, and the relatively new concept of public-private partnerships in development is raised.

The case study is described in **Chapter Six**. Poverty and food consumption patterns in China are described together with the operating environment small-scale mixed cropping and livestock farmers work in. Pastoral system development work carried out in Southwest China over the past two decades, and some of the technologies extended, are also discussed to set the scene for the research.

The methodologies employed in completing the research are described in **Chapter Seven**. Research results are presented in **Chapter Eight** where the current situation and available technologies are described. The research findings are discussed and compared to the literature in **Chapter Nine** and research conclusions are presented in **Chapter Ten**.

2 Family Farm Business Strategy

2.1 What is a farm operating environment?

The environment within which a business operates has three levels (Figure 2.1): the general environment, the competitive environment (sometimes termed the operating environment) and the internal environment (Dobson and Starkey, 1994).

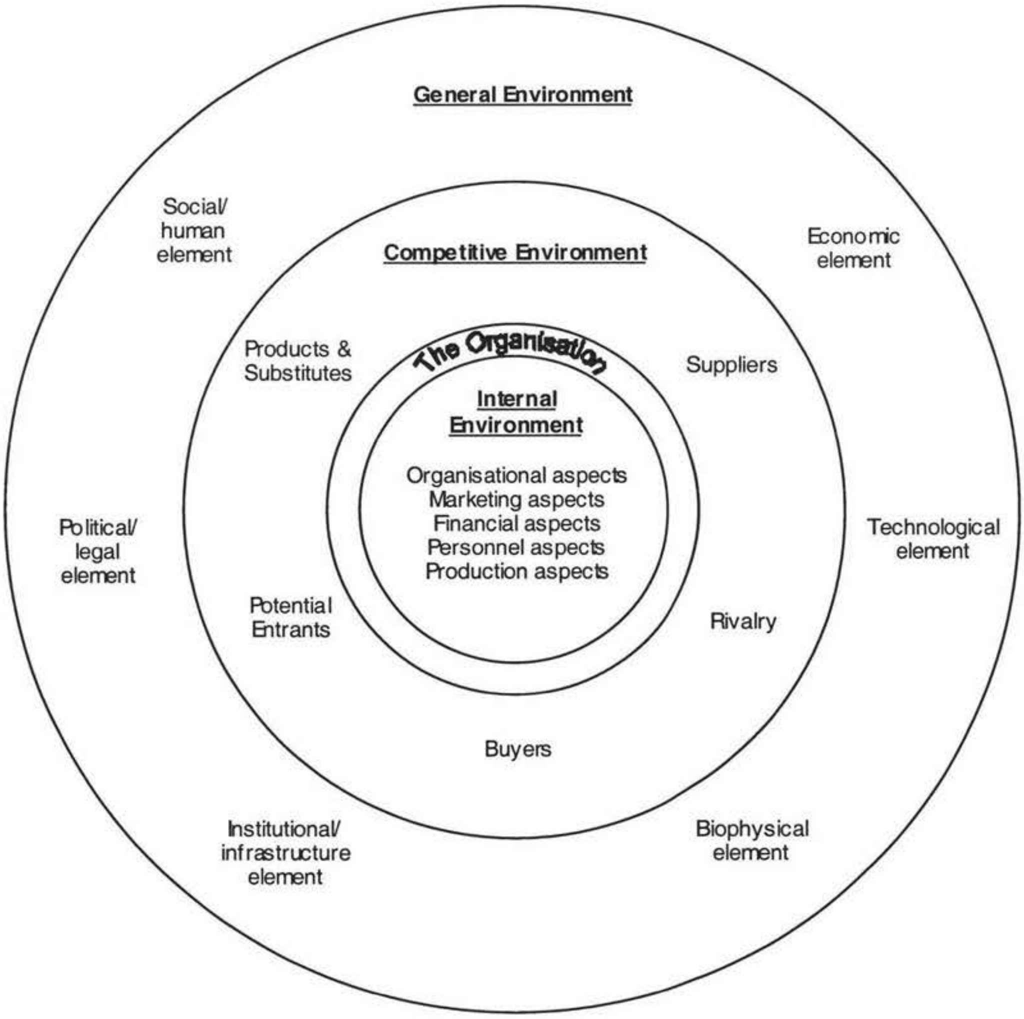

Figure 2.1: The organisation and its environment. Modified from Dobson and Starkey (1994).

Various models have been proposed for analysing the three levels of the environment. Porter's Five Forces Model for analysing the competitive environment is similar to Dobson and Starkey's model, including potential entrants, buyers, suppliers including labour, substitutes, existing firms (Porter, 1980). Value chain analysis (Porter, 1985) is used for internal analysis where a firm's activities are separated into primary and support activities, expanding on the aspects highlighted by Dobson and Starkey. Parker et al. (1997) also discussed the need for three levels of environmental analysis when carrying out strategic planning in grassland systems, i.e., external (PEST = Political/legal, Economic, Social/cultural, and Technical factors), competitor and internal analysis.

Farm systems research introduces a further component of farm operating environments, i.e., the natural, biophysical, or ecological element (Byerlee et al., 1980; Norman et al., 1995; Osty, 1995). This element includes such factors as climate and soils. The biophysical element is unique in that it is part of each level of the environment. Boelhjie and Eidman (1984) also included the biophysical element in their four dimensions of farm operating environments together with the institutional element (e.g., regulations), the social element (e.g., farm family) and the economic element (which determines the prices of input and outputs). There is a further element, the institutional and infrastructure element (Norman et al., 1995), which is related to all of the other components of the general environment.

Therefore, the general farm operating environment consists of six elements:

- The biophysical element
- The technological element
- The social/human element
- The economic element
- The political/legal element
- The institutional/infrastructure element

Each of these elements is discussed in more detail below.

The competitive level of the farm operating environment consists of five elements (Porter, 1980):

- Potential entrants – how substantial are the barriers for a new firm wishing to enter the industry
- Buyers – how much bargaining power do buyers have
- Suppliers – how much bargaining power do suppliers have
- Substitutes – what other products are or could be used instead
- Rivalry – how intense is competition in the industry

All elements of the farm operating environment create variability or risk for the farm business — risk is inherent in all levels of the operating environment.

2.1.1 The biophysical element

The biophysical elements of a farm system can be split into two categories: external factors and semi-external factors. External factors are those over which the farmer and farm family can exert very little or no control. Semi-external factors are those over which the farmer and farm family have been able to modify, or mitigate the effects of, in some way. Factors such as rainfall could be semi-external in flat, lowland areas if irrigation is available. However, in hill regions where irrigation is not an option, rainfall could only be defined as external. In most of the areas in Asia where irrigation schemes are possible, the schemes have been completed (ADB, 1985). The focus of development is now turning to those remote hill and mountainous regions where rainfall is an external factor. Many biophysical factors can be at least partially controlled or modified by the farmer and farm family by employing technology and appropriate strategies (e.g., fertiliser, improved seed varieties/livestock breeds) (Norman et al., 1995). However, the adoption of technology does not eliminate all biophysical risk or variability; sometimes it only changes the nature of the risk (Swenson, 2000).

In pastoral systems, production risk arises from uncertainty as to climatic conditions and the incidence of pests and diseases. Soil fertility and pasture species will influence the magnitude of the seasonal differences in pasture production (Korte et al., 1987).

2.1.2 The technological element

Agriculture development is dependent on technology development. Machinery or practices may become obsolete as new equipment or techniques are created and established as industry standards (Dobson and Starkey, 1994). Government and private spending on research impacts on the rate of technology development available within the industry (Peterson, 1997). The degree of contact with extension services influences the rate of technology adoption (Rogers, 1983; Wadsworth, 1995). In situations where a few large or more progressive farmers dominate the use of extension services, other smaller farmers may be left behind (Wadsworth, 1995). New technology may perform differently to the way expected, or a farmer may be unable to utilise new technology. The technological element is closely related to the biophysical element in that technology can provide the means to increase control over the biophysical element. Norman et al. (1995) even went so far as to suggest that the technical element included the biophysical factors.

2.1.3 The social/human element

Society has a significant influence on farmers and the farm systems operated. Societies have various norms and values, the characteristics of which may depend upon ethnicity, gender and age (these last two particularly with respect to the division of labour and decision making authority). These norms and values are imposed upon all members of the social system, often determining what enterprises are operated, the practices employed, and who operates the various enterprises (Campbell and Barker, 1997). Failure to grow particular crops, own livestock, and use certain technology may result in a family losing status within a social system.

Agriculture is primarily conducted for food production. Food demand is changing from a mass commodity market into a widening array of market segments. Consumers are demanding healthy, nutritional and convenient food products (Barkema and Drabenstott, 1995; Royer, 1995). Similar changes are occurring throughout Asia and particularly in China (Rae, 1995)[2]. Such changes in taste are related to population demographics, levels of education, income distribution, social

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[2] Animal product contribution to daily energy intake in China tripled between 1970 and 1992 from 120 k calories/capita/day to 360 k calories/capita/day (Rae, 1995).

mobility, lifestyle changes, and attitudes towards work and leisure (Dobson and Starkey, 1994). Consumer tastes can also include preferences in animal husbandry techniques, land use management, and organic production methods. These consumer tastes can influence policy direction — animal welfare and production practice policies common in developed nations are often a result of lobbying (den Ouden et al., 1996; Boehljie et al., 1998; Fearne, 1998; Hobbs and Young, 2000).

The availability of skilled and motivated labour and managers are other aspects of the social/human element. Human resource availability is largely determined by labour utilisation, wage rates and overall economic performance. In the long-term, government spending on education largely determines the skills of the human resource (World Bank, 2000). These relationships are particularly strong in developing nations. Another aspect of the human element is the vulnerability of sole operators with respect to injury and health issues, and changing family situations (Martin, 1996; Martin and McLeay, 1997). This vulnerability is again prevalent in developing nations where many farming families are subsistence farmers reliant on family labour, thus ill health or premature death may have a significant impact on the family's ability to produce sufficient food for survival. Poor health care facilities in these nations further exacerbate this risk (World Bank, 2000).

2.1.4 The economic element

Economic strength (local, national, and international if produce is exported) is a key driver of prices received by farmers and prices paid for inputs. Many factors determine economic strength: inflation, unemployment, disposable income, business cycles, interest rates, exchange rates, energy and raw material prices and economic growth rates (Tomich et al., 1995). Price cycles in agriculture are largely determined by the actions of farmers themselves — farmers tend to enter enterprises on highs and exit on lows causing large swings in supply, and therefore, price. Prices can also be heavily dependent upon the biophysical element, particularly climatic events, which affect the enterprise directly or indirectly through the availability of inputs (e.g., grain supplies indirectly affect world beef prices because the US beef industry is largely feedlot based).

2.1.5 The political/legal element

Government stability, its international relationships, and policies have a significant influence on foreign investment in a country. Key policy areas are taxation; industry regulation; employment law; the environment; and trade (Tomich et al., 1995). Government spending is also important. These policies all impact on an economy's performance as highlighted in Section 2.1.4.

Policy is perhaps the most critical element influencing any farm operating environment. Not only does domestic policy (at the national and local levels) impact on farmers, but the policies of other countries also impact on them. This influence is felt nowhere more strongly than in developing nations. Often, these nations are unable to gain access to international markets due to anti-dumping and other protectionist measures demanded by lobbyists and enforced by dominant developed nations (Stiglitz, 1998). Tariffs and export subsidies are the key protectionist tools used by governments[3]. Meanwhile developed nation governments preach to developing nations the need for liberalisation, and in turn dump their own heavily subsidised goods into developing nation markets. A lack of openness by developed nations may cause developing countries to return to similar policies and adopt an autarkic focus as had existed previously (Stiglitz, 1998). As a result, local producers may not be able to take advantage of their competitive advantages, instead being forced to produce goods for sale direct to the government at below market prices.

Domestic policies impacting on farmers include government development goals and strategies, market and price policies, and investment in local infrastructure (Peterson, 1997). Environmental protection, food safety, and animal welfare are areas of policy that are increasingly affecting farmers in both developed and developing nations (Fulponi, 1999; Legg, 1999). Domestic agricultural policy may focus on (Williams et al., 1995; Peterson, 1997; Fulponi, 1999):

[3] Average tariffs on agricultural produce are over 40%, but can be much higher, e.g. the butter tariff in Switzerland is 918%, and the EU tariff on dairy produce is 289% (Fulponi, 1999). The total producer support estimate (PSE) for the EU ranged from 34% to 49% for the period 1986 to 1998, and the OECD total PSE ranged from 31 to 43 for the same period (OECD, 1999).

(i) Public welfare (e.g., food security[4]);

(ii) Price and income stability (e.g., supplementary minimum prices in NZ during the 1970s and early 1980s, maintain low prices for urban consumers);

(iii) Producing surplus agricultural output for export to improve the balance of payments and stimulate economic growth;

(iv) Self-sufficiency in food production is often achieved through protectionist policies required to support un-competitive sectors to reduce risk associated with relying on other nations for food imports which is especially important when other aspects of policy are looked upon unfavourably by those trading partners, and to improve the balance of payments; or

(v) Import substitution often involving the use of subsidies (to improve balance of payments). However, subsidisation of non-agricultural industries discourages production of competitive agricultural goods.

2.1.6 The institutional/infrastructure element

Farm performance and potential are strongly related to farmer access to extension, information, credit, inputs (e.g., labour, fertiliser, water, improved species and cultivars) and markets, and to land tenure (Peterson, 1997; Norman et al., 1995). Access to many of these resources and markets is controlled or limited in some developing nations by government policy. Such control is prevalent in centrally planned economies like China. The situation in China is discussed in more detail in Section 6.3.

Without access to extension and information, farmers are unable to learn about new technologies and new practices. Lack of access to information is caused by two weaknesses — poor communications and an inadequate (or under funded) extension service. Farmers need inputs to utilise new technologies and increase farm output, but access to inputs is often limited in developing countries by inadequate transport and marketing infrastructure (Peterson, 1997), or by an

[4] Food security is closely related to self-sufficiency, public welfare being just one aspect of the policy.

inefficient bureaucracy and, in the case of public monopoly distribution systems, abuse (Nweke and Akorhe, 1983). Extension also plays a role in enabling farmers to access inputs and new technologies — farmers must be told that these inputs and technologies are available, the potential benefits, and where they can be obtained (Röling, 1988; Peterson, 1997).

Access to credit is one way to improve farmer access to new production technology and enable greater use of existing practices. Credit is often unavailable to small farmers because of their inability to provide collateral. However, non-governmental organisations and some government departments have been operating micro-credit schemes designed to provide credit to otherwise excluded farmers (e.g., Grameen Bank) (Nweke and Akorhe, 1983; Baidu-Forson et al., 1997; Peterson, 1997; CIDA, 1999).

Market access and market incentives are important in encouraging farmers to adopt new practices and increase production — without adequate market access, farmers are rational in not boosting output (Baidu-Forson, 1997). The distance to the market, and the road network can limit market access. Governments may set policies on consumer and producer commodity prices including subsidies for inputs or basic food items, or may compulsorily purchase farm products (Peterson, 1997). Labour availability is a related issue — production or increased production of some crops or products may be constrained by the physical lack of a labour force (Byerlee et al., 1980), or the labour force having other more highly paid alternatives. Workers may be limited in their mobility owing to government policy — this perhaps worked in favour of China's farmers in the past when the *hukou* system[5] was more stringently enforced. The type of land tenure and the presence of a land market will also influence the level of investment, and thus, the potential of farms (Byerlee et al., 1980).

[5] The *hukou* system or household registration system designating individuals as rural/agricultural, rural non-agricultural, urban/agricultural or urban/non-agricultural (first legislated in 1958, but introduced in 1955) was primarily designed to prevent rural-urban migration. *Hukou* also provided the means to ration food to urban/non-agricultural residents (rural residents and farmers were unable to obtain rationed food or social welfare benefits) (Zhou, 1996; Williamson and McIver, 1993). It was impossible for rural residents to obtain urban *hukou* prior to 1986 (OECD, 1999).

2.1.7 The types of variability

Emery and Trist (1965) described four idealised types of environment based on causal structures. Causal structure can be taken to mean the processes that generate variety in an environment and, depending upon the nature of these processes, the environment may be predictable or unpredictable. Variety in an operating environment is a function of the distinguishable elements in the environment and the nature of their interaction (Wright, 1985). The four types of environment described by Emery and Trist (1965) are:

(i) Placid and random – favourable and threatening events/outcomes are randomly distributed and unrelated to the behaviour of actors in the environment. The random distribution of events/outcomes means that actors cannot do anything to raise the probability of intercepting favourable events or to lower the probability of intercepting threatening events/outcomes. An actor can only respond to events and outcomes as they occur. Uncertainty is derived from the randomness of events. Kaine et al. (1994) suggested that seasonal conditions could be considered placid and random. Random because the actual sequence of favourable and unfavourable conditions and their severity cannot be predicted. Placid because the farm manager is unable to alter climatic conditions in any way.

(ii) Placid and clustered – favourable and threatening events/outcomes are systematically related. The placid nature of the environment still means that the environment is not influenced in any way by the actors. However, actors can actively aim to maximise performance by learning about the nature of the relationships between favourable and threatening events. Uncertainty is derived from incomplete learning.

(iii) Disturbed and reactive – favourable and threatening events/outcomes are still systematically related, and competitors are also present in the environment. Competing actors' actions actually create favourable and threatening events in the environment. Uncertainty is derived from the inability to anticipate the actions of competitors.

(iv) Turbulent field – interactions between actors are sufficient to cause changes in the environment, and changes can have unpredictable consequences. Change is endemic, and signals present in turbulent fields are often unreliable, ambiguous and misleading. Uncertainty is derived from the complexity of the relationships between actors, and between actors and the environment, and from the continual change occurring in the environment. Kaine et al. (1994) considered agricultural commodity prices as being turbulent. Turbulent fields are characterised by often appearing predictable for quite long periods, but suddenly changing without notice. The reasons for these changes are sometimes obvious, but may equally likely appear unrelated or distant to the element that changes.

Each of these four idealised environments is likely to be present in the different aspects of any real operating environment (Kaine et al., 1994). Variety in an operating environment reduces the level of control the manager has over performance (Wright, 1985). Wright (1985) went on to propose that any element of an environment that exhibits turbulent characteristics will dominate other elements, and that this may still occur even when the other elements are of greater importance. Therefore, the degree to which performance of an organisation can be controlled depends upon the causal nature of the variety exhibited by elements in the operating environment impacting significantly on performance. The greater variety (options) the farm manager has available to respond to variety in the environment, the greater the degree of control the farm manager can exert over outcomes (Kaine et al., 1994).

Risk is the term used to describe a situation where the outcome of an activity being considered or undertaken is not known in advance with absolute certainty (Levy and Sarnat, 1994). Risk can be classified as either business risk or financial risk (Martin, 1996). Business risk is derived from the elements of the environment described above and results in variability in business operating surpluses. Financial risk is associated with being unable to meet the needs of the family or to service debt (Martin, 1996).

2.2 What is a family farm business?

2.2.1 Family businesses

There have been many definitions of what a family business is, each encompassing some or all of: more than one family member involved in the business; family members work within the business; intergenerational transfer; decision making authority; or business ownership (Handler, 1989, cited in Neubauer and Lank, 1998). However, business control is central to most of these definitions. Business control has two components: ownership and management (Neubauer and Lank, 1998). Some family businesses involve total control — family members own the business outright or hold the majority of shares, and hold all or most of the management positions. The business could still be considered a family business if ownership is largely held by one family, but management is non-family; or when a family has sold the business but remain on in a management position (family values and management styles will continue to be exerted on the business).

Neubauer and Lank (1998, pp 8) defined a family enterprise as a "proprietorship, partnership, corporation, or any form of business association where the voting control is in the hands of a given family". Neubauer and Lank (1998) suggested that a family business is one where the family has the final word on the strategic direction of the business.

Family businesses are the most complex form of business organisation (Neubauer and Lank, 1998). These complexities arise because of the need to consider both family relationships (emotions and sentimentality) together with the well-being of the business (objectivity and rationality) and the associated conflict of goals (Robbins and Wallace, 1992). For example, family members employed by the family business or involved in managing the family business may wish to see earnings reinvested in order to ensure future growth in earning capacity or to pass on a viable business to the next generation. However, another family member not employed by the family business may desire a focus on annual earnings and the payment of a dividend.

As well as having a high degree of complexity, family businesses also face the following specific difficulties (Robbins and Wallace, 1992; Neubauer and Lank, 1998):

- Lack of capital for growth;
- Inability in balancing the family's need for liquidity and the business' need for cash;
- Estate planning to ensure the next generation can pay inheritance taxes;
- Older generation dominating younger generation with respect to ownership and management — this can limit growth and innovation;
- Retaining competent and motivated family successors, and also non-family managers (real or perceived constraints on advancement within the company);
- Choosing the family successor — the decision is sometimes not strictly a business decision;
- Setting business goals and objectives, planning business development, and evaluating business position;
- Assigning roles to the various stakeholders and the development of governance structures.

However, family businesses have the following strong advantages that contribute to business success (Neubauer and Lank, 1998):

- The importance of the family name and social standing ensure quality and value for money remain key business values;
- Families are often able to establish good management development strategies for both family and non-family employees;
- Employee and social relationships are strong, which creates both employee and brand loyalties;
- Strategy is long run and targeted to build shareholder wealth, be they current or future shareholders.

2.2.2 Family farm businesses

Gasson and Errington (1993) defined the family farm business as follows:

- Business ownership is combined with managerial control in the hands of the business principals.
- These principals are related by kinship or by marriage.
- Family members, including the principals, provide capital to the business.
- Family members, including the principals, do farm work.
- Business ownership and managerial control are passed from generation to generation.
- The family lives on the farm.

This definition differs little from the host of definitions offered for family businesses, though it is narrower than that offered by Neubauer and Lank (1998) in that day-to-day work is carried out by the owners/managers, and the family lives on the farm.

Gasson and Errington (1993) noted the difficulty the family lifecycle imposes on the family farm business. The family is typically the only source of labour for a family farm, the quality and supply of which will vary with the stage of the family lifecycle. Family farms are often such a size that it is not viable to employ a non-family worker. A non-family farm would not encounter such a problem. However, family members may work for below market pay rates to ensure business survival. Such labour is not available to non-family farms.

Gasson and Errington (1993) also referred to the complexities of intergenerational transfer, suggesting that often a choice needs to be made between efficiency and equity — the choice between maintaining the farm business' viability and treating all family members equally. Similarly, the farm household competes directly with the farm business for capital — a conflict between consumption and reinvestment.

A further difference between family farm businesses, non-family farm businesses, and other family businesses is that reproductive activities and productive activities are often all centred around the farm, as are leisure activities. Some of the non-productive activities do, however, provide a functional advantage to the farm business (e.g., shooting rabbits) (Gasson and Errington, 1993).

2.2.3 Family farm businesses in developing nations

Developing nations predominantly share the characteristic of a labour force overwhelmingly dependent on agriculture (Tomich et al., 1995). Agriculture in most of these countries is dominated by subsistence farmers producing sufficient food for family consumption and possibly a small surplus for sale to enable the purchase of inputs and non-food items such as clothing and education. This group of small farmers frequently depend heavily upon wages earned in rural labour markets (Tomich et al., 1995). However, in some developing nations (e.g., Columbia), there are a small number of large-scale commercially focused farmers within a region, who produce the vast majority of traded products (Tomich et al., 1995).

Small and subsistence farmers are only partially integrated into the broader economy via partial engagement with imperfect and incomplete input and output markets (Ellis, 1988). Joseph Stiglitz, World Bank Group Senior Vice-President and Chief Economist, reiterated the high incidence of "missing and malfunctioning markets" in developing nations (Stiglitz, 1998). Such farmers are also involved in activities other than farming — non-farming (e.g., working as a labourer for a wage) and non-market (e.g., fuel wood and water collection). However, farming is still considered their dominant economic activity. Small and subsistence farmers are different to other categories of farmer in that usually a large portion of output is consumed by the farm family household (Ellis, 1988).

Ellis (1988) went on to describe the core values small and subsistence farmers ascribe to farm resources, and the source and use of those resources:

(i) Land – provides long-term security, social status and is the basis of production and livelihood.

(ii) Labour – family based, and because of this, labour supply and demand is not certain.

(iii) Capital – often used for both production and consumption, and the farm enterprise is not a business, but rather a household.

This definition of core values is strikingly similar to that developed by Gasson and Errington (1993), highlighting such issues as labour supply and demand; land as providing social status and being the basis for production, life and 'recreation'; and the conflict between production and consumption for capital allocation. However, the use of 'business' in Gasson and Errington's (1993) definition is the most important difference between the farm family businesses occurring in industrialised nations and small/subsistence farmers found in developing nations. Small or subsistence farmers are not primarily involved in a business, but rather in survival of the family, and sometimes also a business, depending upon the degree of market integration. Inputs and outputs are however still subject to valuation by this market at prevailing market prices, even if the degree of participation is low (Ellis, 1988).

Small and subsistence farmers are involved in a process of continual change, a transition from being relatively dispersed and self-sufficient to being fully integrated with the market. This transition is often driven by external domestic forces and by even more powerful world forces (Ellis, 1988; Tomich et al., 1995). It could, however, be argued that farm family businesses never attain full market integration. Farm families in developed nations frequently consume some of their own produce (the main exception would be on highly specialised farms producing non-food products). Thus, full market integration is neither likely for small/previously subsistence farmers, nor is it likely to be desirable.

This transition from subsistence farming to market participation provides both opportunities and threats to the small farmer. Greater market participation can increase living standards and allow the family a more diverse consumption. However, market participation raises risk for the farm family (e.g., adverse price trends may influence input/output ratio) and the small farmer is a weak seller (Ellis, 1988). The type of market common in developing nations for meat and vegetables, wet markets, involve intense competition. The many buyers have considerable bargaining power because the products are largely undifferentiated and there are many sellers in the market. Likewise, farm suppliers are powerful — the supply of farm inputs is often dominated by a small number of companies, frequently state owned or operated by people with strong government ties.

In economies where agricultural producers are predominantly small or subsistence farmers, and the integration of these farmers with the market is only partial, there are frequently limitations in the operation of market principles (Stiglitz, 1998). Markets for land, labour (disconnected across location and time), credit, and inputs/outputs are incomplete. Inputs may be available only erratically; transport and communication links may be poor; transactions cannot be replicated (different times and locations); and may involve non-market transactions of unlike goods/services. The poor product and information flows favour those with information, such as traders and officials, over the small farmer (Ellis, 1988). Stiglitz (1986) suggested that a critical factor in determining the degree of fragmentation of a market is the quality of spatial and temporal information flow.

Ellis (1988) suggested that the relationship between small/subsistence farmers is not competitive, and that social responsibility was more important than interfamily competition, as survival of the whole community is paramount. Ellis went on to suggest that in situations where high entry/exit barriers exist due to the lack of markets for land and other resources, the social responsibility may be so high as to create a moral economy.

Contrary to this, in China, family autonomy has always prevailed (except during the state imposed collective farming experiment under Mao Zedong) with no organisations at the village level (Zhou, 1996). However, most farmers do co-operate with each other at times of high labour demand such as planting or harvest (Wang, *pers. comm.*, 1998).

2.3 What is a family farm business farm system?

The key difference between non-family businesses and family businesses, whether they be farming or non-farming enterprises, is the combined role of owner, manager and labourer. The first two roles are discussed with respect to the family farm business, together with the farm resources (including labour) and the farm production system.

2.3.1 The owners

The farm family is the owner of the farm business. Individual family member ownership is unlikely to be equal, more likely to be allocated according to gender and age, or kinship with previous owners (previous generation family members) (Gasson and Errington, 1993). Family farm business owners can be likened to a board of directors for a company who are the elected representatives of shareholders. The role of the board of directors is to determine the goals and values of the company — if shareholders do not agree with the values and goals set for the company, they can sell their shares (most readily in a publicly listed company). The board of directors must also evaluate the outcomes of the business' activities, and determine whether the outcomes are good for the business and whether they are what the business wanted. If the outcomes are not considered in line with the company's values, then the goals will need to be revised. However, in a family farm business, the owners can directly establish their own values and set their own goals.

Values are ends in themselves, pursued for their own sake (Gasson, 1973). Values are the criteria by which individuals select goals, also determining the means by which the goals are obtained (Gasson and Errington, 1993). All members of a social system have values, as they are cultural products of being part of that social system (Gasson, 1973). Typical values are success, freedom, honesty, progress, and hard work. The needs of a farm family change depending upon the stage of family lifecycle. Thus, the farm family's goals will also change to focus the family on meeting those changing needs (Gasson and Errington, 1993), e.g., a change in focus from providing for children's education, to reduced effort in production activities as parents get older. Unlike goals, values do not tend to change with the farm family lifecycle (Gasson and Errington, 1993).

Gasson (1973) suggested four categories of goals:

(i) Instrumental goals – income, security and work conditions

(ii) Intrinsic goals – involvement in purposeful activities, enjoying the work itself

(iii) Social goals – community, family, tradition, relationships and social status

(iv) Personal goals – self-respect, expression and fulfilment

Fairweather and Keating (1994), using Gasson's categories in a review of farmer goals, showed that farmers actually have a wide range of goals: optimise financial returns, business expansion, economic security, personal fulfilment, being independent, facing a challenge, or to improve the biophysical environment. A survey of New Zealand farmers (Parminter and Perkins, 1997) showed that although farmers had a range of goal foci from production, business, and family, to environment, personal growth, and respectability, the most commonly highly ranked goals were production and profit oriented. Another study carried out in Scotland (McGregor et al., 1997) showed the surveyed farmers rank improving the quality of the land, the environment, and their way of life highest. Risk minimisation was also ranked highly. Profit maximisation and resource utilisation, traditionally considered by farm management researchers to be farmers' primary goals, were ranked lower. Other production focused goals also ranked lowly (McGregor et al., 1997). In Harper and Eastman's (1980) study of small farmers in New Mexico, they found that "quality of life" was consistently the highest ranked goal among a list of options offered to the respondents. Family income and risk management were also considered important by this goup.

However, based on experience in developing nations, Byerlee et al. (1980) suggested that almost all farmers have a general goal of increasing income where income is defined to include family consumption. If farmers in developing nations are predominantly attempting to shift from subsistence to greater market integration as Ellis (1988) suggested, it would seem reasonable that greater consumption, attainable via a higher family income, is in fact the goal of many small farm families. A higher income is the means to attaining increased consumption, but the focus on increasing income is modified by food preferences and risk aversion (Byerlee et al., 1980).

Zhou (1996), in her book "How the Farmers changed China" reported a study in Zhejiang Province suggesting that farmers, more than any other social group surveyed, considered making money to be the priority in life. In the early 1990s, farmers selling produce on the free market were able to earn higher incomes than scientists and other state employees (Zhou, 1996). Such findings are contrary to those from developed nation agriculture (e.g., McGregor et al., 1997). However, this survey did not offer other priorities alternative to earning more money, or consider the purpose for making more money.

2.3.2 The managers

The farm family (or at least one member of the farm family) will also be the manager of the farm business. Continuing the analogy with a company structure, the manager is employed by the board of directors to make decisions — decision-making is the most important function managers have (Mintzberg, 1993, cited in Duncan, 1999; Harrison and Pelletier, 2000). Such an analogy is appropriate because *"in managerial terms, the farmers' job is not as different ... from those who manage other kinds of businesses"* (Giles and Renborg, 1990, pp 400-401). Barnard and Nix (1982) also highlighted the central role of decision making in the management task. The purpose of these decisions is to determine the method to be used in attaining the company's goals. Managers may participate in the formulation of the company's goals. Other major functions include interpersonal and informational activities (Mintzberg, 1993, cited in Duncan, 1999).

The earliest view of management focused on three functions: planning, implementation and control (implementation is sometimes split into two sub-functions: organising and coordinating or leading) (Fayol, 1949, cited in Duncan, 1999). Boelhjie and Eidman (1984) further discussed these functions of management and suggested that they were carried out within defined fields or aspects of the business: production, marketing and finance.

Management levels can also be distinguished: strategic, tactical and operational. It is easiest to describe the differences between these three levels when considering planning. Strategic planning is the development of a pattern of action based on predictions about events focused on the means to achieve long-term ends, and such planning usually occurs infrequently and irregularly (Boehlje and Eidman, 1984; Kaine et al., 1994). Wright (1985) suggested that strategy formulation is provoked by the emergence of new opportunities, threats, ideas, and other irregular stimuli in the environment. However, Parker et al. (1997) suggested that strategic plans in a pastoral farming situation should be routinely reviewed and updated, and that strategy continually evolves as a business grows. Strategic decisions in pastoral livestock farming include: stocking rate, sheep:cattle ratio, finishing/breeding, breed(s), lambing/calving dates, and replacement policy (Milligan et al., 1987; Webby, 1994).

Tactical planning is about achieving short-term objectives. Tactical decisions are made more frequently. A tactic is an immediate action in response to events as they occur. Such decisions involve making changes to the farm strategy based on within-year adjustments to fit the actual situation (e.g., weaning dates, overcoming feed deficits) (Parker et al., 1997). Operational planning involves further adjustment of plans to ensure efficient and effective action (Parker et al., 1997).

Although strategy is the overall driver of lower level planning and action, and tactics are an adjustment to the strategic plan (Parker et al., 1997), successful implementation at the operational level determines the attainment of objectives and goals at the highest level (Gray, 1996).

Duncan (1999) defined management as "the coordination of human and non-human resources toward the accomplishment of organisational goals in a way that is acceptable to the larger society". This definition encompasses the three broad functions mentioned above: coordination of resources inherently requires communication and the making of decisions; decisions require information; and social acceptance requires communication and an understanding of that society. Thus, the whole management process and the management decision-making process are synonymous (Simon, 1960; Rougoor et al., 1998; Harrison and Pelletier, 2000).

In a family farm business, unlike in a company, there may only be one person making decisions, decisions at all levels — strategic, tactical and operational. Additionally, this same person will often be entirely responsible for implementing the plans and decisions (i.e., management and labourer are frequently the same individual).

The success of an organisation depends upon the manager's ability to make good decisions that move the organisation towards goal attainment (Harrison and Pelletier, 2000). For a family farm business, this dependence on the manager's decision-making ability still exists. However, unlike a non-family business, the owners are generally unable to remove management due to poor performance, because the farm owners are also the farm managers. For a farm family to remove the farm manager, a member of the family has to relinquish a large part of their existing control. The family only has two options — to find a successor from within the family or to temporarily employ a non-family manager. A family successor may not be readily available or prepared, or none may be willing. Within-family successions often prove difficult due to the host of issues they raise (e.g., income allocation after retiring/redundancy, housing, role of retired manager) (Robbins and Wallace, 1992; Gasson and Errington, 1993; Neubauer and Lank, 1998). Employing a non-family manager may prove uneconomic for the family farm, especially if the farm is small. However, it allows a farm to survive a period of instability within the family and farm business.

For a family farm business, the management role involves strategic decision-making, and tactical and operational decisions that are more technical in nature. The manager of the family farm business may be assisted in operational and tactical decision-making if non-family labour is employed. Thus, farm families largely rely on their own skills at all levels of management to ensure the performance of the family farm businesses (Gasson and Errington, 1993).

The decisions the farm family make are dependent upon their values; their attitudes towards, and perceptions of, the operating environment; and psychological factors. In management decisions, the manager's values are subordinate to the owner's values, and normally these owner values are subordinate to the external environment or society's values (Harrison and Pelletier, 2000). Thus, for a family farm business, the family's values are an ownership element, rather than a management element.

Psychological factors could include intelligence and analytical skills, dogmatism, communication and information seeking, and ability to deal with abstractions. The communication and information seeking factor is central to management, covering two of Mintzberg's three management functions described above. Surveys of managers and the tasks they do (e.g., Duncan, 1999) showed that managers at all levels spend most of their time communicating with people both within the organisation (superiors and subordinates) and outside (customers, suppliers, service providers, competitors), either gathering information, obtaining responses to ideas, or disseminating information. This function, intended to built networks and relationships, could be considered the value chain function of managers.

Perceptions of, and attitudes towards, the operating environment are dependent on the individual farmer and farm family, and are influenced by the farmer's and farm family's experience, learning and knowledge (Rotter, 1966).

The key attitude of farm management is the attitude toward risk. Small-scale farmers in developing nations often consume a large portion of output (Ellis, 1988). Thus, these farmers are generally averse to risks that may endanger their subsistence or sources of cash income, as losses can seriously impact upon their ability to survive (Byerlee et al., 1980; Ellis, 1988; Dillon and Hardaker, 1993). Risk endangering subsistence or a family's survival is equivalent to financial risk described by Martin (1996). There are three broad categories for risk attitude — risk averse, risk preferring, and risk neutral. Farmers may fall into different risk attitude categories depending upon the season, the quantity of resources available at a particular time, the magnitude of costs, and potential gains/losses (Norman et al., 1995).

The key perception of farm management is the perceived degree of control over various aspects of the farm business. Different experiences, learning and knowledge mean farmers will differ in their perceptions of the nature of the operating environment and which elements of the operating environment they can influence or control. Differences in perceived control will lead to different business objectives, and different strategies employed to meet these objectives (Kaine et al., 1994). Kaine et al. (1994) suggested that differences arise in farm performance due to the different strategies used by farmers resulting from differences in their perceptions.

Khatri and Ng (2000) showed that intuitive synthesis was also related to business performance. They found that managers operating in unstable environments used intuition, together with rational analysis, in strategic decision making, and that those managers using intuition achieved better financial performance for their company than those managers who relied solely on rational analysis. The value of intuition in unstable and unpredictable environments is derived from the inherent lack of reliable information on which to base rational analysis. In more stable and predictable operating environments, intuition should be used less, and may in fact have a negative affect on business performance (Khatri and Ng, 2000). Anderson and Dillon (1992, pp 39) also noted the uncertain environment within which farmers must make decisions, and attributed much of their success to *"experience, intuition and native wit and cunning"*.

Farm performance is also influenced by the effectiveness with which farmers can implement the chosen strategy. Figure 2.2 summarises the factors influencing strategy formulation and the resulting farm performance.

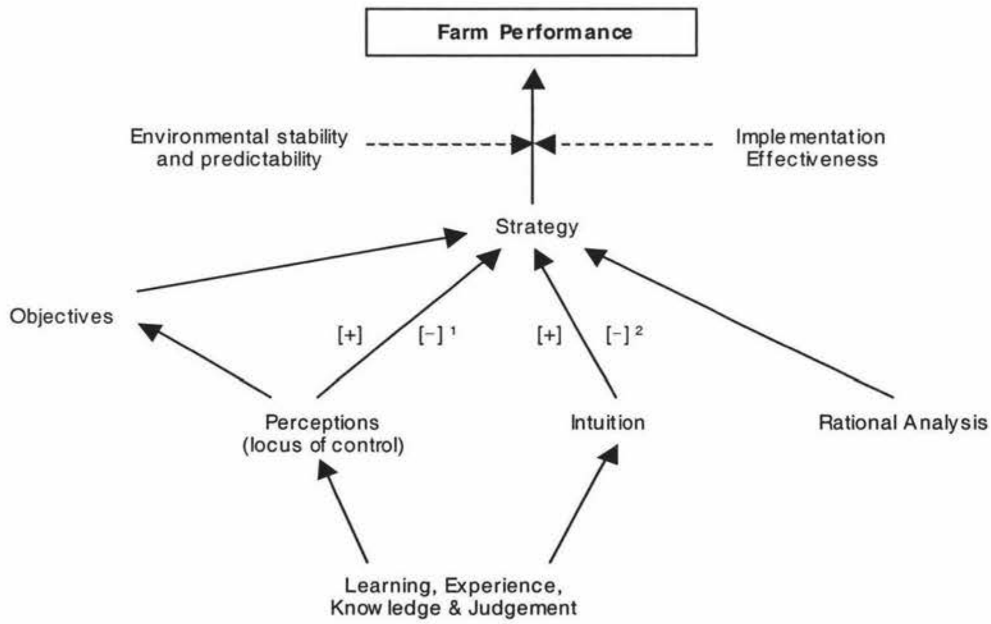

Figure 2.2: Strategy development, the appropriateness of the strategy with respect to the nature of the environment and its influence on farm performance. [1] Locus of control is correlated to farm performance — a farm manager with internal control loci will generally achieve higher farm performance than a farm manager with external control loci. [2] Intuition is positively related to farm performance in unstable and unpredictable environments, though in more stable and more predictable environments, intuition is less valuable.

The concept of locus of control proposed by Rotter (1966) is a measure of an individual's perception of their ability to change a situation, and refers to the individual's beliefs about success and failure. The locus of control can be either internal or external (Rotter, 1966). Where a person believes that an event is largely the product of forces beyond their control, due to environmental unpredictability, then this is a belief in external control. A belief in external control means that the individual believes they have no or little influence over outcomes regardless of their skills and efforts, thus the event or outcome is not associated with personal failure or success (Kaine et al., 1994). Where a person believes they can influence an event or outcome, they are expressing an internal locus of control. With an internal locus of control, the individual believes the outcome is determined by their skills, knowledge and actions, and is therefore associated with personal success or failure (Kaine et al., 1994).

Farm managers expressing an internal locus of control with respect to production efficiency, cost of production, and innovation would achieve higher performance compared with those farmers expressing an external locus of control for these elements (Kaine et al., 1994; Tanewski et al., 2000). However, farm managers should exercise caution when making frequent and substantive changes to their farm systems based on anticipated prices, because prices are turbulent fields (Kaine et al., 1994).

Variation in performance is inevitable as there are elements of the operating environment genuinely outside a farm managers' control, but farm managers should develop a strategy to minimise this variation by controlling those aspects of the business or environment identified as controllable, and avoiding or reducing contact with those aspects identified as uncontrollable. To achieve best performance, farm managers should have perceptions and strategies that follow the causal structure of variation in the environment (Kaine et al., 1994). Wright (1985) suggested that risk would be minimised when the number of tactical options are equal to the number of variations in the environment.

2.3.3 The resources

Resources can be categorised in many ways, however the most common approach has been to define resources as land, capital and human. The quantity and quality of resources varies between households, influencing performance and the system potential (Byerlee et al., 1980; Ellis, 1988; Norman et al., 1995; Tomich et al., 1995; Campbell and Barker, 1997). This is the situation for farmers operating in any environment, but in developing nations, the resource constraints are far more apparent. Resources categorised as land include livestock and buildings, i.e., the physical resources of the farm production system. These physical resources will generally be limited in quantity available to an individual farm family and to the entire farmer population. Access to resources can occur without ownership (e.g., public grazing land as has until quite recently been common in China; borrowing draught animals in exchange for human labour; land rental). However, this lack of ownership can influence the ease and intensity of use for an individual, in turn affecting the performance of the system (Norman et al., 1995).

Capital resources are the financial resources, either equity or debt, available to the farm family. Debt (credit) markets may not always be present in developing nations (Ellis, 1988), or if they exist, lending institutions may not wish to lend to small farmers due to lack of collateral (CIDA, 1999). Capital resources can often be exchanged for other resources such as labour, land or livestock. However, in many developing nations, government policy prohibits this, particularly with respect to land (Byerlee et al., 1980). Capital resources are usually expanded by the business creating value, or through the sale of assets; however, the sale of assets is really a transfer from one resource category to another.

Human resources involve strategic through to operational management skill, technical competency and labour. Labour supply for a farm family changes throughout the lifecycle of the family, and the quality of this labour will change as the family members age and gain experience and knowledge (Gasson and Errington, 1993). Access to labour may be constrained either by the lack of labourers, or by the availability of capital to pay for labourers. Managerial ability and technical skill varies widely amongst households, regions and ethnic groups (Norman et al., 1995). Farmer management and technical skills will improve with experience and learning, however the rate of learning may be constrained in situations where communications and extension services are poor or non-existent.

Access to all of these resources and resource markets is often not available to farmers, being beyond their control, and depends upon government policy and other industry actors (Campbell and Barker, 1997; Peterson, 1997).

2.3.4 The farm system

A system is a group of components that interact to perform a function. Production systems are biological systems that transform inputs into outputs. Management systems are systems used by managers to design and control the production system(s) to achieve a desired end (Reid, 1996). Farm systems are the combination of production systems and management systems and are the result of farm management's strategies. Farm systems are the combination of the farm business resources, allocated in a way decided by the farm manager, and evolved over time in direct response to farm and environmental influences in order to achieve the management objectives (Byerlee et al., 1980; Merrill Sands, 1986; Chambers and Jiggins, 1987a, 1987b). Osty (1995) suggested five farm management decision foci in the design of farm production systems:

(i) Utilisation of land;

(ii) Enterprise mix;

(iii) Investments in plant and machinery;

(iv) Labour allocation; and

(v) Operating income allocation.

Management objectives are set to assist the manager to achieve the farm owner's goals.

Farm systems are usually a group of interrelated production processes or sub-systems (enterprises) each producing different products, but with the same end-point (Spedding 1975; Osty, 1995). For example, a farm system may include the production of sheep, cattle and maize — these sub-systems are integrated and complementary to each other, and employed to achieve the farm family's goals (Byerlee et al., 1980; Merrill Sands, 1986; Chambers and Jiggins, 1987a, 1987b; Norman et al., 1995; Devendra, 1995).

2.3.5 Farm systems in developing nations

Farm systems in developing nations are often mixed farming systems producing crops and animals, and in Asia, mixed farming systems are agriculture's backbone

(Devendra, 1995). Farm systems operated by small-scale farmers are often complex, risky and dynamic (Perrin and Winkelmann, 1976; Byerlee et al., 1980; Anderson and Dillon, 1992; Norman et al., 1995). The primary purpose of these systems is to provide the family with sufficient food for an active and healthy life. In some situations where farmers are resource poor (e.g., remote mountainous regions), this may be the only purpose (i.e., the situation for peasants or subsistence farmers) (Ellis, 1988). The secondary purpose is to generate cash income, particularly in peri-urban areas. Livestock and livestock produce are often the most important source of cash income for farming families in developing nations [6] (Sansoucy et al., 1995).

Cropping dominates agriculture in terms of economic importance. However, livestock production is still a major component of the agricultural economy[7], a contribution that goes well beyond direct food production by providing (Sansoucy et al., 1995):

- Cash income
- Living bank
- Provision of draught power
- Manure for fertiliser and fuel
- Cultural value

This is contrary to the predominant income generation role that livestock play in developed nations. In China, beef has traditionally been considered a by-product of cattle (Simpson et al., 1994).

Mixed farming systems in Asia are characterised by (Devendra, 1995):

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[6] Rice, milk, wheat, beef/buffalo meat and pork are the first five ranked agricultural commodities by value in developing nations. Eggs, poultry meat and sheep/goat meat rank 9, 20 and 21 respectively (FAO, quoted in Sansoucy et al., 1995).

[7] Livestock and livestock products contributed 19% of total agricultural/forestry/fish output by value in developing nations for 1987-1989. The contribution of livestock in Asia was slightly less at 17% (FAO, quoted in Sansoucy et al., 1995).

- A diverse use of resources;
- Reduced and spread risk;
- Small farm size;
- Integrated crops and livestock;
- Multipurpose roles of crops and livestock;
- Many ruminants and non-ruminants;
- Low level of inputs and the use of traditional practices.

Different farm systems are operated depending upon the ecosystem. In lowland irrigated regions, cattle and buffalo together with non-ruminants dominate, while in semiarid, arid and highland regions sheep and goats are more common. In rain-fed upland regions, similar to the focus of this research, cattle, buffalo, sheep, goats, pigs, fish and poultry are all common (Devendra, 1995).

2.4 Planning and Designing Systems

Planning is about attempting to shape events. Planning occurs at three levels: strategic, tactical, and operational. Only strategic and tactical planning will be discussed here as these two types of planning have a much greater influence on overall performance. A strategy may well include a series of tactical options to use once knowledge is available or events have occurred.

2.4.1 Development of improved systems

The manager is responsible for coordinating resources (human and non-human) within a system towards the attainment of the business goals (Duncan, 1999). Therefore, the manager's purpose is to ensure the business accomplishes the goals set by the business owners. A goal is an intended level of performance to be achieved. To achieve this intended level of performance, the system must be improved, made more efficient, more productive or more profitable. Thus, because the manager is responsible for coordinating resources and inputs, and for goal achievement, developing improved systems is the manager's task. The process of improving systems and managing systems are therefore synonymous. Further, the management decision-making process is also synonymous with system improvement. Thus, these models are just differing interpretations of the same activity: management. However, the process of system improvement still warrants discussion as it advances the concept of management being a cycle and describes the activities of managers.

Reid (1996a) outlined three broad steps in the cyclical process of developing improved systems: understanding, analysis and synthesis. System improvement is cyclical because the environment is changing continually due to the unpredictability of many elements. The first step in developing improved systems is to gain an understanding of the existing system. An understanding of the function of the system and the performance drivers will enable the manager to predict the likely outcomes, or range of possible outcomes, if certain changes are made. This understanding is of course a precursor of successful management — appropriate resource coordination would be purely fortuitous without such understanding.

The second step, analysis, is when problems and opportunities are identified. Sets of potential solutions are determined together with tactical options if the problems or opportunities are of a short-term nature. Problems and opportunities generally arise due to changes in the operating environment. When determining solutions to overcome or take advantage of these changes in the environment, the manager must be able to classify environmental changes as either a short-term instability or a significant longer-term change (Wright, 1985).

Synthesis, the third step, builds upon the alternatives developed during the analysis stage. The tactic or option chosen becomes part of the business strategy, becoming integrated into the existing farm system in a way that is acceptable to the wider community.

2.4.2 Strategies for agriculture and overcoming variability

Porter (1985) described three general competitive strategies for firms:

(i) Cost leadership – being the lowest cost producer employing vigorous cost control, minimum overhead levels, scale of operation, and ensuring high efficiency. Cost is the focus rather than the customer.

(ii) Differentiation – emphasise product quality and unique characteristics with a focus on consumer tastes and preferences rather than price.

(iii) Specialisation – focus on the production of a certain product at high volume with high quality, sometimes in a niche market.

If, as Ellis (1988) suggested, small/subsistence farmers do have a non-competitive relationship, are these competitive strategies appropriate for small or subsistence farmers? Another factor that must also influence the appropriateness of these strategies for small and subsistence farmers is their access to resources, which is often limited (Nweke and Akorhe, 1983; Swanson et al., 1984; Baidu-Forson et al., 1997; Campbell and Barker, 1997).

Development is a transformation of society; a process of social change intended to result in social and economic advancement of individuals within a social system, including greater equality and freedom for individuals leading to an improved vitality of life (Stiglitz, 1998). Development for small and subsistence farmers must therefore mean a transition from isolation and self-sufficiency to greater integration with the market and society. Market integration leads to competition, desired or not by the farming families, in the market place between farming families for inputs and resources.

As noted above in Section 2.2.3, market integration increases variability for the farm family. In a self-sufficient system, the family is only exposed to placid and random variability associated with seasonal differences, while in a system even only partially integrated with the market, the family is exposed to turbulent market variability.

In an environment that is predictable, strategy can be based upon clues from the environment, used to anticipate future events and to allow proactive responses. Performance in a predictable or semi-predictable environment will be determined by tactical flexibility and the farmer's capacity to learn about, understand and manipulate the environment. The appropriate strategy is therefore to change the level of variety in that element of the environment, both internally and externally (Wright, 1985; Kaine et al., 1994).

In an unpredictable environment, the focus of strategic planning shifts to ensuring adequate tactical flexibility — the strategic objective is to maximise tactical options (Wright, 1985; Kaine et al., 1994). The two key elements of farm operating environments are seasonal variations and prices. Both elements are unpredictable, the first being placid and random, and the second being turbulent (Kaine et al., 1994). Hence, there is a need for a series of options to counter unforeseen events, of which there will be many.

The preferred strategy in such an unpredictable environment is to change the causal structure of the environment (Emery and Trist, 1965). For a placid and random environment element, such as seasonal conditions, flood stop banks or irrigation schemes would represent a strategy changing the causal structure of the environment (Kaine et al., 1994). If this approach is not feasible, the next best strategy is to aim for maximum tactical flexibility.

For a turbulent element, Kaine et al. (1994) suggested the development of a set of 'values', which are shared by all members of the environment. This set of 'values' or code of conduct constrains the behaviour of all members, creating greater predictability (Emery and Trist, 1965). Kaine et al. (1994) proposed that price support schemes and other similar forms of intervention were such a strategic approach, but they would eventually fail as such schemes did not consider all members of the environment. Therefore, the best strategy for an individual farmer is one of risk minimisation and maximum tactical flexibility. This strategy can be realised by minimising the average cost of production and retaining cash surpluses as liquid assets. Such a strategy allows the farmer to absorb large variations in returns without financial ruin.

Tanewski et al. (2000) in their review of the role of planning in family farm business performance suggested that farmers perceiving greater environmental certainty were more likely to use sophisticated planning techniques (e.g., strategic, operational and succession planning). In situations with high uncertainty, forecasting in the short-term is difficult, thus long-term planning could well be redundant. In such situations, farm managers should maintain flexibility (Tanewski, 2000), and place greater emphasis on experience and intuition (Khatri and Ng, 2000).

Agriculture is a commodity industry, thus the differentiation strategy is difficult to implement for farmers in any nation (Boehlje, 1992). However, it could be argued that the nature of agriculture is changing with the establishment of brands based upon differentiation (e.g., New Zealand's venison and kiwifruit brands, Cervena and Zespri), and the establishment of farms specialising in the production of produce for a specific market.

To emphasise quality, a business needs to understand what it is that customers value in terms of the purchased package (Greenan et al., 1997). Quality can be split into two types: customer perceived quality, and conformance quality (Greenan et al., 1997). The first type, quality differentiation, allows premiums to be earned providing profit and business growth. The second type, conformance quality, requires a business to compete on cost of conforming to ensure that market share does not shrink, to maintain business profitability and growth.

Perceived quality is the most important factor affecting business performance. However, quality conformance is essential if the business is to ever make a first sale (Greenan et al., 1997).

A quality advantage boosts performance in two ways. In the short-term, superior quality raises profitability via premium pricing. In the long-term, superior and/or improving quality should result in increased market share (Greenan et al., 1997). Over time, a perceived quality characteristic is likely to become a conformance quality characteristic, as customers' perceptions and expectations change.

A specialisation strategy would only be appropriate if economies of scale could be used to ensure lower costs for production, but economies of scale are not likely to be an option in small farmer populations. Further, in economies with imperfect and incomplete markets, the risk of producing just one crop would be intolerably high for a small or subsistence farmer. Small farmers typically avoid risk by diversifying crop production, even if some of the planted crops are less profitable and/or less preferred as foods (Byerlee et al., 1980). This strategy is commonly employed by many small farmers throughout Asia (Devendra, 1995). Such a strategy ensures that the family will have at least some access to the main food groups valued by the family, reducing "financial" risk, and also serving to reduce "business" risk as total output is protected. However, a specialisation approach may also be suitable, even for a small farmer, if a contract or alliance was established with a customer, since such an alliance should remove much of the turbulent market risk.

Small farmers attempting to lift their market integration are strongly exposed (often for the first time) to turbulent market forces, particularly for purchased inputs, and for traded outputs to a lesser extent. In these circumstances, cost control will be important, and a cash reserve may be difficult to maintain in situations where the family has not regularly earned cash income before. Cost control may therefore be the most appropriate initial competitive strategy (Porter, 1985) for small farmers in developing nations attempting to increase their degree of integration with the market.

Fixed or non-enterprise specific costs which do not vary with output are typically a high portion of total costs for farmers. Boehlje (1992) suggested that traditional cost control strategies such as variable cost reduction are not very effective in high fixed cost industries such as agriculture because variable costs are a low portion of the total costs. One of the largest fixed costs is the cost of capital (equity and debt). Farms with high fixed costs are less adaptable to changing economic conditions and less able to adopt innovations. To reduce the impact of market and production variation, fixed costs as a portion of total costs and gross farm income should be minimised (Boehlje, 1992).

Selling assets does not always reduce fixed costs for a farming family where consumption (cost of equity) is a large portion of fixed costs — the family cannot suddenly start consuming less because some of their asset base has been sold. Increasing output from the existing asset base may not always be possible due to any combination of resource constraints. Increasing the size of the asset base may not always be possible either. There are two main reasons for this:

(i) Market imperfections and incompleteness – in many developing nations, land and other resource markets, including those for inputs, are incomplete (Norman et al., 1995; Peterson, 1997) and, in the case of China, almost non-existent (Crook, 1997; OECD, 1999; Tuan and Ke, 1999). Thus, it is not possible to purchase further resources to expand the operation.

(ii) Lumpiness of resources as investments – resources such as land cannot usually be purchased in small units, thus such investments are 'lumpy'. The large amounts of funding required are often more than the farm family can source from either equity or borrowing.

In a subsistence farming system, fixed costs, the cost of equity or family consumption, are equal to total costs. By definition, subsistence farmers have no market contact and use only self-produced inputs. These fixed cash costs are also equal to gross income. However, income here would not include cash, but would include products grown solely for consumption. For subsistence farmers with fixed costs being equal to family consumption, the common strategy of converting fixed costs to variable costs is not available. Thus, to change the cost structure, the subsistence farm family must generate some cash income and become involved in the market. As a farm family progresses away from subsistence towards greater market integration, fixed costs will continue to dominate expenditure — the cost of equity may increase as the family eats better food and educates children, and variable costs will rise in absolute terms as the family increases production. The family should eventually raise production to such a level that costs as a proportion of gross income decline (Figure 2.3).

This does not leave the small farmer many strategic options to achieve the targeted progress. The small farmer is forced to adopt a cost control approach coupled with a more intensive production system from the existing asset base, with emphasis on fixed costs, as variable cost expenditure will be essential if the farmer intends to produce their way into a better future. However, an over-rigorous cost control strategy may inhibit opportunity seeking and the provision of quality and value to customers.

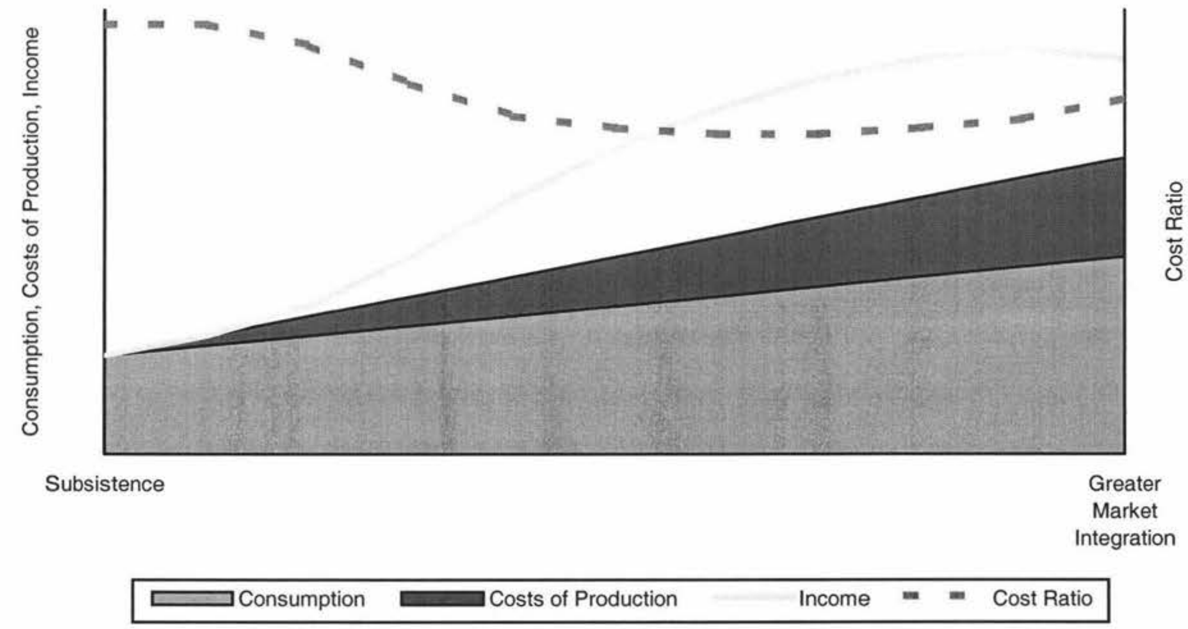

Figure 2.3: Concept of changing cost ratio as degree of market integration increases (Cost Ratio = (Consumption + Costs of Production) ÷ Income, where Income = Consumption + Cash).

Alternatively, or in combination with cost control, a farmer may be able to enter into a contract or alliance with a customer to reduce market risks. Thus, with agreed price and access, the farmer is able to produce a single product to high quality specifications.

At an industry strategy level, Tomich et al. (1995) suggested that policymakers should focus on providing innovations, inputs, incentives, infrastructure, institutions, and initiative in order to achieve the type of development Joseph Stiglitz envisages. These six components are central to the development strategy proposed by Stiglitz (1998) and discussed in Chapter 5.

2.5 Chapter summary

- Strategy is the overall driver of lower level planning and action, and tactics are an adjustment to that plan. However, successful implementation at the operational level determines the attainment of goals at the highest level.

- Strategic decisions on pastoral livestock production systems include: stocking rate, sheep:cattle ratio, the selection of finishing or breeding policies, animal breed, sale dates, and calving and lambing dates.

- The key attitude of farmers is their attitude towards risk. This attitude is related to an individual's situation and capabilities.

- The key perception of farmers is their perception of which aspects of their farm business they exercise some degree of control over. This perception is related to experience, knowledge, and learning.

- An internal locus of control means that an individual associates outcomes with personal success or failure. An internal locus of control is positively related to farm performance.

- Operating environments can be: random and placid, placid and clustered, disturbed and reactive, and turbulent.

- Intuition is positively related to business performance in unstable and unpredictable environments.

- In placid and unpredictable environments, the preferred strategy is to change the causal structure. The next most preferred strategy is to maintain a high level of tactical flexibility.

- In more turbulent environments, the preferred strategy is for environment participants to establish a mutually agreed value set. The next most preferred strategy is to maintain a high level of tactical flexibility.

- Generic business strategies are: quality differentiation, cost leadership in meeting quality conformance standards, and specialisation. Perceived quality is the most important driver of business performance.

- Specifically poor and small farmers:

    - Consumption is often a large proportion of total output;

    - Generally averse to risks that endanger income, survival, or family consumption; and

    - Increased market integration increases exposure to turbulent market forces.

3 Adoption and Extension of Innovations

3.1 The Adoption Process

3.1.1 What are innovations?

An innovation is any idea, practice or material item perceived to be new — innovations are change objects (Zaltman and Duncan, 1977). Innovations can be designed to cause change; and sometimes change, especially in an operating environment, can encourage innovation (Zaltman and Duncan, 1977; Röling, 1988). Changes caused by innovations may also be unanticipated (Rogers, 1983). Innovations each have form, function and meaning, with meaning being the hardest characteristic of the innovation to determine prior to diffusion and extension (Rogers, 1983).

(i) Form – the directly observable physical appearance and substance of the innovation.

(ii) Function – the contribution made by the innovation to the way of life of individuals within a social system.

(iii) Meaning – the subjective and frequently unconscious perception of the innovation by members of the social system. Technologies developed in one culture or situation can often have quite different meanings when transferred to a different culture or situation. Change agents generally do not understand the meaning of introduced innovations, especially the negative consequences. This situation can easily arise when the change agents are heterophilous with the target category (Rogers, 1983).

3.1.2 What is the adoption process?

The adoption process is better termed the *innovation decision process* because the potential adopter may adopt *or reject* the innovation. The purpose of the innovation decision process is to collect information and analyse that information in order to reduce the uncertainty about the advantages and disadvantages of the innovation for that individual (Rogers, 1983).

Several models of the innovation decision process have been established. The first model developed by Lionberger (1968, cited in Campbell and Barker, 1997) initially had five stages within the process (Figure 3.1). However, Lionberger later identified that these stages were not so distinct and that some of the stages could become condensed.

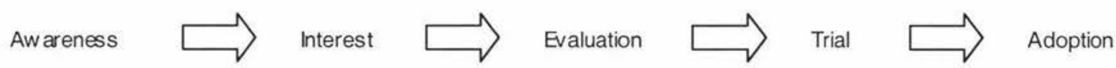

Figure 3.1: Lionberger's adoption model. Adapted from Campbell and Barker (1997).

The second model, put forward by Rogers (1983), also includes five stages, but continues beyond the initial decision stage to a confirmation stage where a "final" decision is made. This "final" decision is required to ascertain whether to continue or discontinue using the innovation if already adopted, or to adopt or to continue rejecting the innovation after previously rejecting it (Figure 3.2).

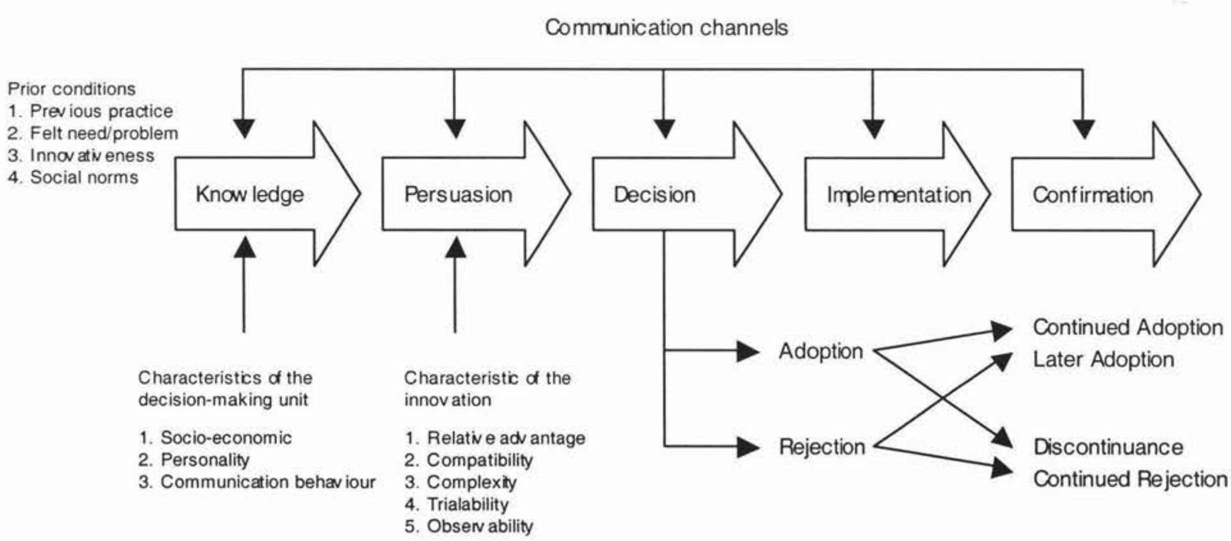

Figure 3.2: Rogers' model of stages in the innovation decision process. Adapted from Rogers (1983).

Rogers (1983) defined the five stages:

(i) Knowledge – an individual is exposed to the existence of an innovation and gains an understanding of the form and function of that innovation.

(ii) Persuasion – an individual forms a favourable or unfavourable attitude towards the innovation.

(iii) Decision – an individual engages in activities that lead to a decision to adopt or reject the innovation.

(iv) Implementation – an individual puts the innovation into use, i.e., the innovation is actually adopted.

(v) Confirmation – an individual seeks reinforcement of the prior innovation decision. In this stage, the earlier decision may either be sustained or reversed.

This model also includes some of the variables influencing the rate of adoption of innovations to be discussed in Section 3.2.

The two models described are quite similar. Lionberger's model provides more detail of some activities carried out by an individual in making the initial decision, and groups others together. Lionberger's (1968) awareness and interest stages could readily be grouped together to form Rogers' (1983) knowledge stage. The evaluation stage of Lionberger's model is similar to Rogers' persuasion, and probably includes the decision stage as well — the individual is analysing the advantages and disadvantages based upon knowledge of the innovation, arriving at an attitude towards the innovation, and then making a decision to try the innovation or not. Rogers termed the next stage implementation whereas Lionberger's term is trial. Assuming Lionberger's definition of trial actually included implementation on a small scale, these two definitions could be considered comparable.

The final stage is making the final decision after a period of time in which the innovation is used (possibly on a small scale). Again, both definitions appear quite similar in encompassing the concept of innovation trialability — confirmation in Rogers' (1983) model and adoption in Lionberger's (1968) model.

The synonymous models of management, management decision, and system improvement discussed earlier show significant similarities to these models of adoption and innovation decision. Therefore, It could be appropriate to suggest that the management process and the innovation decision process are also synonymous.

3.2 Factors Influencing the Rate of Adoption

Rogers (1983) defined a paradigm of five variables determining the rate of adoption of innovations: perceived attributes of innovations; type of innovation decision; communication channels; nature of social system; and extent of change agents' promotion efforts. However, a survey of key adoption theory studies (Rogers, 1983; Röling, 1988; Arnon, 1989) identified two further factors, i.e., individual and situation characteristics and industry characteristics. Two of Rogers' (1983) variables, communication channels and extent of change agents' promotion efforts, could be grouped as one. Thus, there are six broad factors identified as influencing the rate of adoption of new technologies and practices:

(i) Individual and situation characteristics

(ii) Industry characteristics and the nature of agriculture

(iii) Innovation characteristics

(iv) Society characteristics

(v) Extension method(s) and change agent effort

(vi) Type of innovation decision

Further, there are six key participants determining the characteristics of these six factors:

(i) Farmer and farm family

(ii) Extensionist

(iii) Researcher

(iv) Government

(v) Industry

(vi) Society

3.2.1 Individual and situation characteristics

This factor is similar to what has frequently been described as "innovativeness". Rogers (1983: pp 22) defined innovativeness as the degree to which an individual is relatively earlier than other comparable individuals in adopting innovations.

Most recent research has neglected to include this variable as one of the factors influencing the rate of adoption, but instead has assumed that if extension target category definition is correct, then there will be no difference between the producers targeted for the innovation (Röling, 1988). However, it is widely agreed that individuals will adopt at different times, and that individuals can be defined along an adopter category continuum (Rogers, 1983; Arnon, 1989; Rogers, 1995). Adopter category definition is based around the s-shaped curve of adoption (Rogers 1983).

Many investigations cited by Rogers (1983) support the statement that, over time, adopter distributions follow a normal curve, and such a curve is even used by marketing specialists (e.g., Moore, 1999). The widely accepted adopter categories are innovators, early adopters, early majority, late majority, and laggards (Rogers, 1983; Arnon, 1989; Rogers, 1995; Moore, 1999) (Figure 3.3).

Rogers' (1983) definition of innovativeness accounts for some of the characteristics included in this individual and situation characteristics variable, such as psychological factors, life-cycle stage, and risk aversion. Rogers (1983) went on to describe the differences in socio-economic factors characterising the five adopter categories. These factors included age, literacy, education, social status, farm size, attitude towards debt, degree of commercial orientation, and degree of specialisation. However, these factors do not allow for a full description of an individual's situation, particularly with respect to access to resources and inputs, but are some of the factors farmers consider when making the decision to adopt or reject an innovation. Swanson et al. (1984) deemed access to resources important for consideration when developing appropriate technology.

In a study of farmer preferences for socio-economic and technical interventions in the groundnut growing regions of Niger, Baidu-Forson et al. (1997) found that farmers saw no advantage in adopting new technologies until market and credit constraints were removed. Frank (1995) found, for beef farmers in North Queensland, that the perceived reward attributable to environmental influences varied directly with socio-economic need — declining financial returns encouraged a higher level of innovation adoption. Given examples of the influence of socio-economic factors in both developing and developed nations, socio-economic factors must be included in any model of the determinants of adoption.

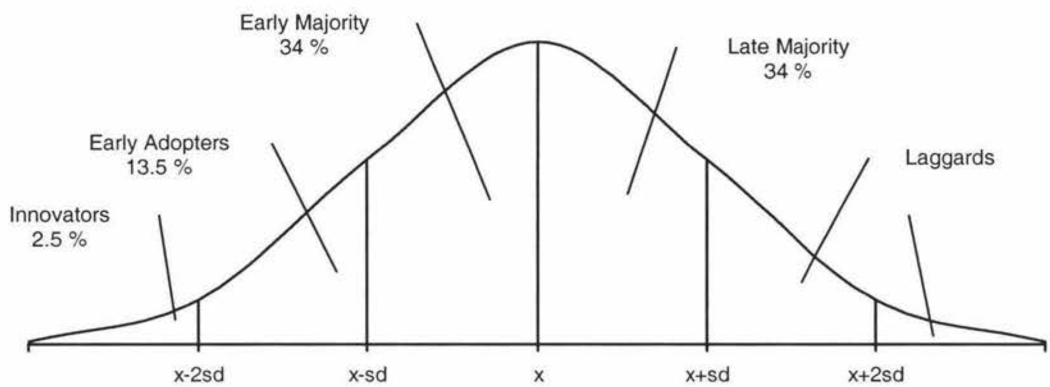

Figure 3.3: Adopter categorisation based on the normal bell-shaped curve and innovativeness. Rogers (1983). Note: s.d. = standard deviation, x = mean.

Resource access and socio-economic factors have generally been excluded from models of determinants of the rate of adoption, assuming that differences between individuals are eliminated by the creation of target categories for innovations (e.g., Röling, 1988). However in practice, regardless of the effort exerted in defining the target categories, entirely homogeneous target categories can never be defined (Röling, 1988), thus is it is valid to include individual and situation characteristics as a variable influencing the rate of adoption of innovations.

Arnon (1989) reiterated the need to consider resource access and socio-economic factors when he stated that for innovations promoted in developing nations, the majority of farmers did not follow the progressive and richer farmers in their area. This group cannot be considered laggards, but rather non-adopters. This group is not a minority as are laggards in Rogers' (1983) model, but rather a majority of non-adopters, not by choice but by force of circumstances (Arnon, 1989) (Figure 3.4).

Rogers, in his fourth edition of "Diffusion of Innovations" (Rogers, 1995), also accepted that in developing countries, farmers might not adopt, not because they are "laggards" or do not want to, but rather because their situation does not allow them to adopt the innovation.

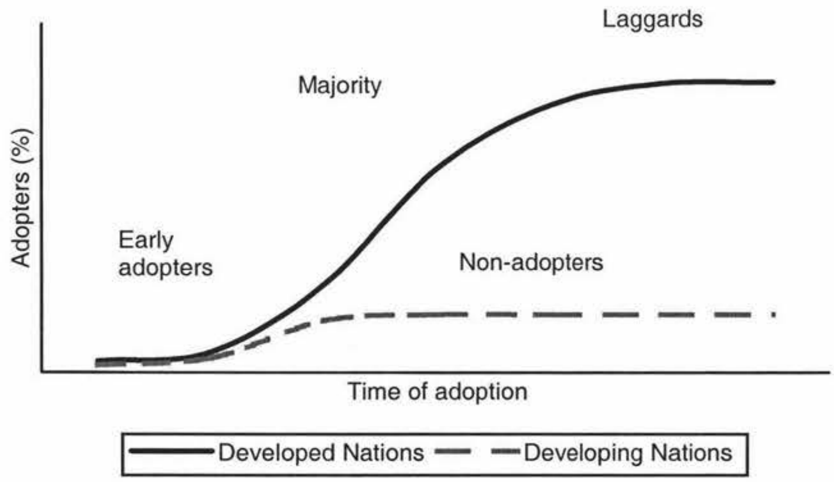

Figure 3.4: Contrasting patterns of adoption of agricultural innovation in developed and developing nations. Adapted from Arnon (1989).

Therefore, definition of individual and situation characteristics includes two broad sub-categories: desire – motivation and goals; and capacity – the skills and access to necessary resources (Chambers and Conway, 1992). An individual's desire to adopt an innovation is dependent upon their: goals; farming principles and philosophies (e.g., organic farming, do they see themselves as guardians of the land, is succession important?); age; lifecycle stage (Rogers, 1983; Gasson and Errington, 1993); and psychological make-up (Rogers, 1983). Ethnic group should be added to this list because, in multiracial societies, different dogmas and reasons for farming can exist (Campbell and Barker, 1997).

Rogers (1983) suggested that innovativeness was related to socio-economic factors. Rather, or at least more importantly, the capacity of an individual to adopt and the applicability of the innovation to an individual are largely related to socio-economic factors (Nweke and Akorhe, 1983; Swanson et al., 1984; Baidu-Forson et al., 1997).

Resource access and socio-economic factors influencing adoption are summarised from Swanson et al. (1984):

- Land – size of farming area, tenure (owner-operated, family land, leased land, share-farmed).
- Labour – family or household, hired (cost and availability), communal.
- Water – irrigated land or dryland.
- Inputs – availability of the material components of the innovation.
- Markets – location, availability and cost of transport and storage.
- Capital – sources, cost and ease of obtaining credit.
- Information – media distribution, availability of extension services.
- Influence – ability of the individual to effect technology development, claim-making capacity.

Government and business also directly influence many of these factors as they can control policy and the market.

Individual and situation characteristics may not actually influence the *rate* of adoption, but rather the *decision* to adopt or reject, and the appropriateness of the innovation for the target category. However, an individual's desire and capacity may change over time. Therefore, *adoption* or the decision to adopt is related to socio-economic factors and farmer access to resources, while the *rate of adoption* is related to the rate of change in socio-economic factors and farmer access to resources. This may explain the exclusion of resource access and socio-economic factors from models of factors influencing the rate of adoption.

3.2.2 Industry characteristics and the nature of agriculture

The nature of agriculture and the characteristics of the industry within a social system are closely related to, and impact upon, an individual's situation and the relative advantage that can be obtained from an innovation, and therefore, the rate of adoption of an innovation.

Agriculture in most developing nations is dominated by small-scale[8] (Sevendra, 1995; Tomich et al, 1995), frequently subsistence farmers, producing sufficient food for family consumption and possibly a small surplus for sale to purchase inputs and non-food items such as clothing and education. However, there are usually a small number of large-scale commercially focused farmers within a region, who produce the vast majority of traded products. These farmers can generally obtain regular assistance from governments and their extension services because they control the supply of marketed products, and thus, have much greater access to resources such as inputs and information, together with easier market access (Nweke and Akorhe, 1983; Baidu-Forson et al., 1997; Peterson, 1997). This means that it is easier to design innovations that suit their conditions than it is to develop innovations for low access and resource-poor farmers — the large-scale and high access farmers can accept higher risk, and an increase in their productivity will have a much greater impact on the volume of produce available for sale (Röling, 1988). These farmers do not belong to the same category as subsistence farmers, thus this should influence the type of innovations developed — innovations suitable for intensive, large-scale farms are unlikely to be appropriate for subsistence farmers.

Agricultural policy will determine the category(s) of farmers targeted by the extension service, and will thus determine the rate of development of the different categories of farmer. The extension strategy commonly used is the progressive farmer strategy, concentrating on the large-scale, commercially orientated farmers (Section 3.4.1).

The presence of subsidies for produce or practices will strongly encourage the use of technologies that produce higher yields of the subsidised crop/animal product, or are associated with the subsidised practice. The impact of farm subsidies can be illustrated with an example from New Zealand — the removal of subsidies from New Zealand agriculture in the 1980s meant that applying fertiliser on much of the steep hill country became unprofitable, with farmers preferring to focus on debt reduction

[8] In 1990, average farmland per agricultural worker in developing nations (58 countries defined as CARLs = Countries with Abundant Rural Labour) was 1.79 ha (cropping land was 0.54 ha). In China, there was 1.08 ha farmland per agricultural labourer and only 0.21 ha of cropping land (lowest in the world). In comparison, the US had 150 ha of farmland per agricultural labourer and 66 ha of cropping land (Tomich et al., 1995).

(Reynolds and Ramavatnam, 1990). Management practice subsidies are now widely used in the European Union — one of the most common is for changing to eco-farming practices, as is used in Switzerland (Roux and Blum, 1998).

User charges and penalties are the converse of subsidies. User charges may be employed to encourage resource-conserving technology (e.g., taxes or input levies on fertilisers and pesticides in Europe (Pretty, 1998)). Penalties may be used to discourage the use of environmentally unfriendly practices (e.g., taxes to limit pollution from livestock in the Netherlands (Pretty, 1998)) or for not using an innovation, or for not meeting quality requirements. Penalties for low quality are more typically charged by companies buying primary products from farmers such as is common with New Zealand dairy and meat processing companies (Shadbolt, *pers. comm.,* 2000).

Government policy also influences market access and availability of credit and inputs. These factors are determinants of adoption of innovations (Nweke and Akorhe, 1983; Baidu-Forson et al., 1997).

In a highly regulated industry, producers may have to follow strict production techniques to ensure market access; or they may not be allowed to sell on an open market, instead being limited to supplying only the government on a quota basis. Such a government quota system was used in China from 1958 to 1978 during the period of the peoples' communes initiated by the Great Leap Forward[9]. Farmers, collectively, first had to pay the state levy, in effect an agricultural tax, and then to satisfy the state purchase quota at prices fixed by the government. Grain surpluses could only be sold to government departments (e.g., grain stations under the Ministry of Grain) through the unified state purchase system; private marketing of grain and other agricultural produce was prohibited (Xu and Peel, 1991; Wang and Davis, 1992; UNDP, 1996).

[9] By the end of 1958, all 735,000 advanced agricultural cooperatives established in 1956 had been transformed and merged into 26,000 communes (UNDP, 1996).

3.2.3 Innovation characteristics

Rogers (1983) identified five characteristics of innovations that influence the adoption of that innovation: relative advantage, compatibility, complexity, trialability, and observability.

3.2.3.1 Relative Advantage

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 1983), and can typically be expressed economically (e.g., improved efficiency, lower costs, increased output) or as status giving. Every innovation is at least partially assessed economically by potential adopters, however an innovation might also confer some increase in status (Rogers, 1983). Potential adopters, when assessing the economic reward associated with adopting an innovation, consider the profitability, start-up costs, impact on task discomfort, labour requirements and the immediacy of the reward (e.g., payback period).

Incentives, monetary or non-monetary, are one method of raising the relative advantage of adopting an innovation, particularly those innovations designed to confer either some social benefit requiring a major behavioural change (e.g., family planning) or some preventative measures (e.g., soil conservation and other ecological practices (Roux and Blum, 1998; Pretty, 1998)). Rogers (1983) suggested:

(i) Incentives increase the rate of adoption – adopter incentives increase relative advantage, while diffuser incentives increase the communicability with which an innovation is perceived.

(ii) Adopter incentives lead to adoption of innovations by individuals different to those who would otherwise adopt. Adopter incentives particularly raise the rate of adoption by low socio-economic status individuals.

(iii) Although incentives increase the number of adopters, the quality of such adoption may be relatively low, leading to a limitation in the intended consequences of that innovation and the continuity of its use.

The perceived relative advantage of an innovation is positively related to its rate of adoption (Zaltman and Duncan, 1977; Nweke and Akorhe, 1983; Rogers, 1983; Fujisaka, 1994; Guerin and Guerin, 1994; Wadsworth, 1995; Roux and Blum, 1998).

3.2.3.2 Compatibility

Compatibility is the degree to which an innovation is perceived to be consistent with the existing socio-cultural values, beliefs, experiences, previous ideas and needs of potential adopters (Rogers, 1983).

Often innovations are not viewed singularly by potential adopters or by the people involved in the development of the innovation, but rather as a package of interrelated ideas and technologies. This is often due to the compatibility of these innovations. Higher rates of adoption have been achieved when packages of innovations have been diffused, compared to the same innovations extended separately (Rogers, 1983). This has especially been the case with packages of crop cultivars, fertiliser and herbicides in developing nations (e.g., Swaziland – Rauniyar and Goode, 1996). However, farmers are often not in a position to fund or carry the risk of total adoption, so the final adoption of the package may occur over time as farmers adopt single technologies in a stepwise pattern en route to complete package adoption (Nagy and Sanders, 1990).

The perceived compatibility of an innovation with a production system or a social system is positively related to its rate of adoption (Zaltman and Duncan, 1977; Rogers, 1983; Fujisaka, 1994; Guerin and Guerin, 1994; Wadsworth, 1995). Rogers (1983; 1995) suggested that compatibility as a factor is less important in predicting the rate of adoption than other characteristics of the innovation (e.g., relative advantage). However, Rogers (1995) was unable to offer an explanation, but noted that the difficulty in measuring perceived compatibility might be a reason.

3.2.3.3 Complexity

Complexity is the degree to which an innovation is perceived to be difficult to understand and use (Rogers, 1983). Not all innovations are as clear in meaning or as straightforward to implement as other innovations. A number of studies (Zaltman and Duncan, 1977; Rogers, 1983; Guerin and Guerin, 1994; Wadsworth, 1995) suggested that the rate of adoption of an innovation is negatively related to its complexity.

3.2.3.4 Trialability

Trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 1983). The trialability of an innovation is positively related to its rate of adoption. Innovations that can be tested on-farm and on a small scale will be more readily adopted than those indivisible innovations (Zaltman and Duncan, 1977; Rogers, 1983; McDermott, 1987; Guerin and Guerin, 1994).

Trialability is a more important characteristic of an innovation for early adopters than for later adopters. This is because early adopters have no on-farm precedent to follow whereas later adopters are able to observe the consequences on their peers' farms (Rogers, 1983).

3.2.3.5 Observability

Observability is the degree to which the results of an innovation are visible to others (Rogers, 1983). The results of some innovations are readily observed, and therefore communicated to others, while other innovations are difficult to describe or demonstrate. Innovation observability is positively related to rate of adoption (Rogers, 1983; McDermott, 1987). Generally preventative innovations are less observable, and thus are adopted more slowly (Rogers, 1983; Lamble, 1984).

3.2.4 Society characteristics

The characteristics of society that influence the rate of innovation adoption can be categorised as either social norms or the degree of social interconnectedness (Rogers, 1983; Röling, 1988). Social norms and values can be closely related to ethnicity, age, and gender — these last two particularly with respect to the division of labour and the decision-making authority. In many farming systems, women play a much greater role in the production of food-crops than in income-generating crops, and within the cropping system have specific functions to carry out (Campbell and Barker, 1997). An innovation, that increases yield may initially be adopted for that reason, then later rejected as the social group responsible for dealing with the consequence of the innovation may have insufficient time to process the total yield, thus proving the innovation inappropriate (Campbell and Barker, 1997). Different ethnic groups may have specific cultural or religious ideas or beliefs that make a new practice unacceptable to them (Campbell and Barker, 1997). Innovations may also have negative social connotations, requiring individuals within a social group to do something they find unacceptable (e.g., Malagasy farmers do not maintain or expand hedgerows because they are associated with French settlers and the colonial government) (Fujisaka, 1994).

The degree of interconnectedness within a social system is positively related to the rate of adoption of innovations (Rhoades and Booth, 1982; Rogers, 1983; Röling, 1988). This is because of the social system's self-generated pressures toward adoption. The magnitude of this pressure changes as the proportion of individuals within the system adopt. This increasing pressure from the social network on individuals is termed the "diffusion effect." As more individuals adopt or reject the innovation, there is increasing peer pressure from within the social networks on those individuals who have yet to adopt or reject that innovation, because the norms of the social system change over time as the diffusion process occurs (Rogers, 1983). As the number of individuals adopting/rejecting the innovation increases, awareness and knowledge is more widespread throughout the social system, and this social interconnectedness is another driver of adoption or rejection of an innovation (Rogers, 1983). McDermott (1987) supported this generalisation, and suggested that diffusion and adoption are largely a function of the "farmer dynamic."

3.2.5 Extension method(s) and change agent effort

Rogers (1983) included this factor in his model as two separate variables — communication channels, and extent of change agents' promotion effort. However, change agent effort and communication method are closely linked during the various stages of the adoption process and it is appropriate to combine them to form a single broad factor.

Rogers (1983) suggested that if interpersonal channels must be used to create awareness and increase farmer knowledge of the innovation, the rate of adoption would be slowed. However, Campbell and Barker (1997), using Lionberger's (1968) model of the adoption process, suggested that the most appropriate method of communication or extension changes as the adoption process progresses, both within a social system, and for an individual. The amount of effort expended also changes as the method of communication changes (e.g., interpersonal contact will require greater change agent effort than mass media communication).

The effect of the extent of change agent promotion effort on the rate of adoption changes over the diffusion period for an innovation (Rogers, 1983), thus there is a greater pay-off for extension effort at certain stages within the adoption process, both for a social system and for an individual.

If success of a change agent's activities is measured as the number of farmers adopting an innovation, then efficiency in contacting as many potential adopters as possible and effectiveness with which those potential adopters are contacted will determine the change agent's success. Extent of change agent promotional effort could be classified as efficiency; however, the effort will be wasted if the method of contact/communication is not appropriate (i.e., ineffective). Thus, part of the change agent's effort should be directed at determining the most suitable communication technique for both the targeted category of farmers and the identified stage of the adoption process for the targeted category (Campbell and Barker, 1997).

3.2.6 Type of innovation decision

There are three basic types of innovation decisions: optional, collective, and authority innovation decisions.

(i) Optional decisions are choices to adopt or reject an innovation made by individuals independent of the choices made by other members of the social system (Rogers, 1983).

(ii) Collective decisions are choices to adopt or reject an innovation made after a consensus is reached among the members of a group or system (Rogers, 1983). Collective decisions are more complex than optional decisions because they are composed of a collection of individual decisions (Lamble, 1984), and such decisions may be slower to be arrived at than optional decisions.

(iii) Authority decisions are choices to adopt or reject an innovation made by a small number of individuals who possess power, status or technical expertise within the system (Rogers, 1983). These choices are forced upon the individuals (or adoption unit) within that system. This one-way or forced adoption approach can result in rapid and widespread adoption. However, changes brought about in this way are unlikely to be fully accepted by those that adopt them, and may not be permanent (Lamble, 1984). Greater acceptance of the change and continuity in innovation adoption is achieved if the adopters are more widely consulted and participate in the decision-making process (Lamble, 1984).

Innovation decisions are not always made in isolation — sometimes they can only be made after an earlier decision is made. An example of such a sequence of decisions would be a farmer deciding to adopt a supply contract with a meat processing company, which could only occur after the meat company decided to adopt the use of supply contract and make them available to farmers. These sequential innovation choices are contingent innovation decisions (Rogers, 1983; Lamble, 1984).

The type of innovation decision impacts upon the rate of innovation adoption — the more people involved in the decision-making process, the slower the rate of adoption. Adoption will generally occur more rapidly where the decision is an optional decision made by an individual rather by a collective or authoritarian leader (Rogers, 1983).

3.3 The Consequences of the Adoption of Innovations

Consequences of the adoption of innovations can be: desirable or undesirable, direct or indirect, and anticipated or unanticipated (Rogers, 1983).

Desirable consequences are the functional effects of an innovation on an individual or social system, while undesirable consequences are the dysfunctional effects of an innovation. Innovations can often have both desirable and undesirable consequences — usually desirable effects for the adopters and undesirable effects for other members of the social system (Rogers, 1983). Direct consequences are the changes that occur to an individual or social system in immediate response to an innovation. Indirect consequences are the changes that occur to the individual or social system due to the direct consequences of an innovation (Rogers, 1983). Indirect consequences can affect individuals other than those adopting or rejecting an innovation — a financial advantage may be realised by those individuals who adopt an innovation, widening the socio-economic gap over rejecters (Rogers, 1983;

Röling, 1988). Anticipated consequences are those changes intended by the individual or social system to occur. Unanticipated changes are those occurring that were not intended or expected, and are usually negative affects on a social system (Rogers, 1983).

Decisions to not adopt or to reject environmentally sustainable practices can affect individuals quite remote from the decision-maker (Chambers and Conway, 1992). Such consequences are indirect, unanticipated, and undesirable. Examples of indirect, unanticipated and undesirable consequences of innovation could include changes in rural social structures (such as family, gender, community, and governance relationships) as a result of mechanisation (Zaltman and Duncan, 1977) and Green Revolution technologies (Farrington et al., 1993).

The benefits of an innovation may change as the number of farmers adopting the innovation increases and can be unequal in distribution (Röling, 1988). As noted in Section 3.2.1, early adopters tend to have relatively larger farms, more capital, are able to carry more risk, and may be more specialised or commercially oriented than those farmers that are slower to adopt or choose not to adopt (Nweke and Akorhe, 1983; Rogers, 1983; Swanson et al., 1984; Röling, 1988; Baidu-Forson et al., 1997; Campbell and Barker, 1997). Agricultural technologies (e.g., the Green Revolution technologies (Farrington et al., 1993)) have generally been designed to raise yield, lower cost, and reduce labour input. The early adopting farmers can take advantage of the innovation, and produce higher yields and continue to earn at the current price. Total production will soon increase to a level causing the price to decline, thus those farmers who have not adopted will see their incomes drop, unless they have managed to raise their yields at a compensating rate (Rogers, 1983; Röling, 1988). Therefore, the socio-economic situation of the later adopters and the non-adopters will deteriorate relative to the early adopters. This situation is worse where socio-economic inequality is already significant (Gotsch, 1972; Rogers, 1983). Röling (1988) suggested that the process of unequal distribution of innovation benefits is self-reinforcing.

3.4 The Extension Process

Röling (1988), citing Zuurbier (1984), defined extension:

- Extension is an intervention;
- Extension uses communication as its instrument to induce change;
- Extension can be effective only through voluntary change;
- Extension focuses on different outcomes to other forms of communication; and
- Institutions use extension.

Extension is essentially the practice of institutions attempting to induce voluntary change in a targeted population. Central to agricultural extension is technology transfer. Technology transfer is the process of moving scientific and technical knowledge, ideas, services, inventions and products from the origin of their development to where they can be put into operation (Guerin and Guerin, 1994). Adoption is the implementation of this transferred knowledge (Rogers, 1983).

3.4.1 Extension strategies

Extension services generally use one of two extension strategies: the progressive farmer strategy, and the target categories strategy (Röling, 1988). The progressive farmer strategy relies on the diffusion of innovations from progressive or innovative farmers to less progressive or innovative farmers (Rogers, 1983). Arnon (1989) suggested that the progressive farmer strategy is based on two guiding principles formulated by extension workers:

(i) It is useless for extension workers to devote time to laggards who will either not adopt or be the last to adopt an innovation.

(ii) Extension efforts should be concentrated on innovators who are the most open to new ideas, and will be able to implement innovations — once these progressive farmers have adopted the innovation, the other farmers will follow anyway.

Such a strategy clearly excludes the bulk of farmers in less favourable situations from technology development, extension, and the adoption of new technologies (Röling, 1988). This observation has led to a change in the extension approach towards targeting homogeneous categories of farmers rather than the heterogeneous population (Rogers, 1983; Röling, 1988; Arnon, 1989). Failure to appreciate the differences in individual characteristics within a population, or focusing on just the progressive farmers, can often have quite negative consequences on the majority (see Section 3.3).

Farmer populations are not homogeneous, but rather heterogeneous (Röling, 1988; Rogers, 1983). Ignorance of the reasons for this heterogeneity (psychological, life-cycle, social norms, access to resources, and access to information) leads to the assumption underlying the progressive farmer strategy that all farmers are the same, and is probably the greatest weakness of the approach. Even though a population may be heterogeneous, it may still be homogeneous relative to the purpose of the intervention. This same principle applies when identifying target categories.

The key components defined in Röling's (1988) principle of target categorisation are:

(i) Relevant variables are identified to segment the heterogeneous population into categories that minimise the variance of the relevant variables.

(ii) Individuals within each category are analysed as to the most important to decision making about interventions.

(iii) The intervention programme content and extension strategy is based on the above information.

(iv) Representative individuals of the target categories are used to test the programme content and strategy.

(v) The intervention programme is implemented to selectively impact upon the intended target category.

Röling (1988) noted that these steps in the intervention programme strategy closely resemble the principles and procedures of marketing. Each step is important, however the first step has sometimes been disregarded, causing Röling to state *"one thing is certain: if extension does not systematically select a target category, such a category will self-select in the form of innovative farmers"* (Röling, 1988).

3.4.2 Extension practices

Within these two strategies, there are many different practices employed to transfer technology in extension programmes (Rhoades and Booth, 1982; Stoop, 1988; Chambers, 1994; Moris and Copestake, 1993; Reid, 1996b; Van den Ban and Hawkins, 1996; Scarborough et al., 1997; Röling and Van de Fleirt, 1998). Reid (1996b) suggested that these practices make up a continuum from top-down transfer of technology through to participatory technology development. These practices are summarised in Table 3.1 below.

All of these extension approaches can rely on the diffusion of innovations from the farmers who visit the demonstration farms, are supported by visits from extension officers, and have high access to information generated by these services. But by using a targeted categories strategy, extension can be more effective because the technology is extended only to those farmers to whom the technology is relevant (Rogers, 1983; Röling, 1988; Arnon, 1989).

Table 3.1: Summary of the extension practices continuum.

	Role of farmer	Role of scientist	Role of extensionist	Techniques & methods used	Purpose	Outsider perceived reasons for non-adoption
Top-down	Passive receiver of technology	Developer of "blueprints"	Pass "blueprints" to farmers	Extractive surveys, questionnaires	Farmer education, transfer of technology	Farmer ignorance
Feed-back	Mainly passive receiver of technology	Developer of technology	Extend technologies, feed-back farmer opinion to scientists	Extractive surveys, questionnaires	Farmer education, transfer of technology	Farmer ignorance and constraints
Training & Visit	Mainly passive receiver of technology, assist in problem identification	Developer of technology	Provider of off-the-shelf innovations, supply agri-inputs to farmers	Regular extensionist visits to farms, discussions, on-farm research	Problem solving for farmers	Farmer ignorance and constraints
Farm systems research	Problem definition, source of local knowledge	Synthesis of survey data, technology development	Extend technologies	On-farm research, RRA, modelling, extractive	Outsider learning, removal of constraints	Farm level constraints
Farmer-back-to-farmer	Problem identification, technology adaptation, evaluation	Problem identification, solution development, solution testing	Problem identification, solution development, solution testing	On-farm research, RRA, participation	Generation of acceptable (to farmers) technology	Inappropriate technologies, farm level constraints
Farmer field schools, demonstration farms	Investigator, technology developer, observer	Problem identification, solution development, solution testing	Problem identification, solution development, solution testing	Participation, discussion, observation, joint decision-making, field days	Farmer development of technology, raise farmer knowledge and analytical skills	Inappropriate technology
Participatory methods	Analyst, investigator	Facilitator, catalyst	Facilitator, catalyst	Participation, PRA, discussion, observation, diagramming	Participatory development of technology, empowerment of local people	Inappropriate technology

The most recent development in extension is farmer-led extension, or farmer-to-farmer extension. Scarborough et al. (1997) suggested that a critical barrier to development in complex, diverse, and risk-prone areas where many people are living below poverty thresholds is the failure to find institutionally viable ways to provide appropriate technical support to households. Farmer-to-farmer extension involves farmers undertaking extension activities with or without the support of external agents (Scarborough et al., 1997). Farmer extensionists may be trained by other farmers or by external extension officers, and can sometimes be paid by the farmers they serve, or even by external agencies. Such extension systems are often established in places where no other service is provided. Other benefits of farmer-to-farmer extension identified by Scarborough et al. (1997) are:

(i) Language – farmers speak the same language literally and culturally;

(ii) Relevance – farmers understand the local problems, constraints, potentials, and goals better than outsiders;

(iii) Availability – farmers are often available when professional extensionists may not be;

(iv) Accountability – farmer extensionists are more accountable than professional extension officers;

(v) Credibility – farmer extensionists have the same background and operate under similar constraints as other farmers;

(vi) Sustainability – at the end of the intervention or project, the farmer extensionists stay on in the community and may continue to encourage other rural development initiatives.

Farmer field schools are also a form of farmer-led extension as they "return the locus of interaction to farmer fields" with an "emphasis on decentralised educational processes and *in situ* discovery and learning by farmers" and, without doubt, are very participatory (Scarborough et al., 1997; Röling and van de Fliert, 1998). This argument seems fair, however care would need to be taken that not only progressive farmers participated (Röling, 1988).

3.4.3 Matching the Extension and Adoption Processes

Campbell and Barker (1997), using Lionberger's (1968) model, described the appropriate focus of the change agent's effort at different stages within the adoption process together with suitable methods of communication and extension (Figure 3.5). however, this model assumes that technology is transferred from scientists and extensionists to farmers, and that farmers are not capable of developing their own technologies. This assumption does not align with the participatory technology development processes currently employed in both developing and developed countries.

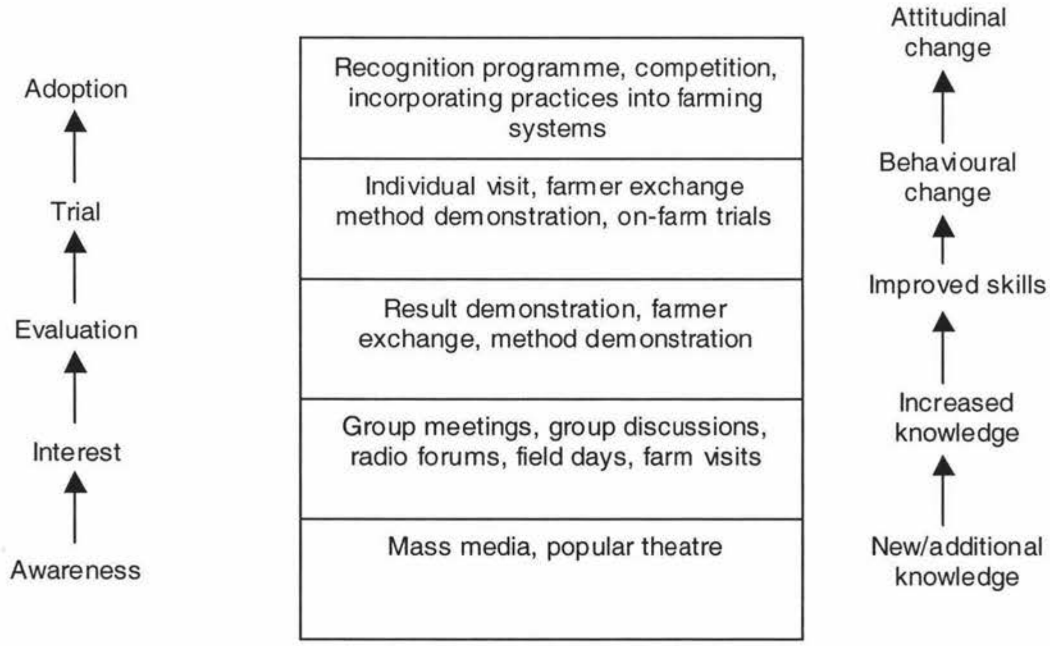

Figure 3.5: Recommended extension methods for use at different stages of the adoption process. Source: Campbell and Barker (1997).

Van den Ban and Hawkins (1996) also summarised the functions of extension methods, and largely support Campbell and Barker's (1997) model. Mass media methods are most suitable for creating awareness of innovations and transferring knowledge. Demonstrations are appropriate for creating awareness of innovations and problems, transferring knowledge, and encouraging behavioural change. Folk media methods are suitable for creating awareness of problems (also innovations), activating learning processes, and transferring knowledge. Group discussions are most suited to creating awareness of local problems, encouraging behavioural change, activating the learning process, and utilising other farmers' knowledge. Interpersonal contact and farm visits are highly useful in creating farmer awareness of their own problems, and in adjusting solutions to best fit farmer situations and problems; they also play a role in transferring knowledge, encouraging behavioural change, and activating the learning process (van den Ban and Hawkins, 1996).

3.5 Chapter summary

- An innovation is an idea, practice, or item that is perceived to be new. Innovations are change objects.
- The adoption process, or innovation decision process, follows four general steps: awareness and knowledge of the innovation, evaluation of the innovation, the decision to implement the innovation, and the decision confirming the initial choice.
- There are six broad factors influencing adoption of innovations: individual and situation characteristics, industry characteristics, innovation characteristics, society characteristics, change agent effort and extension methods employed, and the type of innovation decision.
- Non-adoption of an innovation occurs not because the non-adopting farmers are "laggards", but rather because they do not have either the capacity or the desire to implement the change.
- There are five characteristics of an innovation that influence its adoption: relative advantage, compatibility with the existing system, complexity, trialability of the innovation, and observability of the innovation and the innovation's advantages.
- Extension is the practice of institutions attempting to induce voluntary change in a targeted population.
- There are two main extension strategies: the progressive farmer strategy, and the targeted strategy. The latter is accepted as the preferred strategy, and is generally expected to provide the greatest benefit to farmers.
- There are many extension practices, ranging from the top-down method when farmers are the passive receivers of technology to participatory methods when farmers and outsiders develop technology together, and the local people are empowered.

4 Industry Organisation & Supply Chains

4.1 Co-ordination of firms

The scope of the firm is determined by the decision to 'make or buy', such decisions being fundamental to business planning. The point at which it becomes marginally more expensive to organise a transaction internally than externally, determines the boundary of the firm (Coase, 1937). However, even supposed market relations often involve some sort of close co-operation such as shareholdings or long-term contracts. Richardson (1972) developed Coase's theory further to suggest the 'market' and 'firm' are not opposing terms, but rather the end points of a continuum from pure market to pure firm. Richardson (1972) described three broad alternative ways for a firm to coordinate activities and secure continued access to all necessary inputs and outlets for its operation. Richardson termed these alternatives market transactions, co-operation between firms, and consolidation of operations within one firm. Williamson (1971, 1973) explained that co-ordination does not occur just through the market mechanism because of the existence of co-ordination errors. Co-ordination errors are created either intentionally through opportunism and imbalanced market power, or unintentionally by the bounded rationality of firms who produce too little or too much due to uncertainties of the market.

Gerybadze (1995), building on Richardson's work, termed these three alternatives:

(i) The market solution – based upon links between independent agents in the market who will provide the required skills, inputs or resources at the appropriate time.

(ii) The integrated solution – when a firm gains control through ownership over the whole, or most of, the supply chain in order to secure the required skills and resources.

(iii) The co-operation solution – involves co-operation between two or more independent firms with respect to a specific project. Ownership and management of the separate firms is not fully integrated. The co-operation strategy has been suggested to be an intermediate or hybrid form of the other co-ordination strategies (Richardson, 1972).

Williamson (1979) described a further means of co-ordinating firms: trilateral governance or neoclassical contracting relying on a third party to assist or arbitrate in resolving disputes and to manage the relationship for the two principals.

Williamson (1979) asserted that two critical dimensions for describing contractual relations are the frequency with which transactions recur and the specificity of the assets (Table 4.1). Uncertainty is even more important in influencing co-ordination — as uncertainty increases, co-operation, contracts, and internalisation becomes increasingly important; while in situations with declining uncertainty, the benefits associated with co-operation and internalisation also decline (Williamson, 1979).

Williamson (1979) suggested that highly standardised transactions do not need a specialised governance structure and that only recurrent transactions would require specialised governance. Occasional transactions of the non-standardised type (for example, the sale of goods produced using highly specific assets), will not support transaction-specific governance because the set-up costs can often not be recovered, but require an intermediatary form of governance (Williamson, 1979). Barkema and Drabenstott (1995) provided a natural extension of Williamson's factors influencing a firm's choice of co-ordination structure. If a firm's transaction frequency is high relative to competitors, these transactions should be co-ordinated internally and supported by a dedicated administration system. However, as transaction frequency increases throughout the entire industry, opportunities to exploit economies of scale via specialisation favour external co-ordination. Increasing industry-wide transaction frequency typically results in standardised transactions, again more suited to external co-ordination. Transaction standardisation can ease a firm's administrative burden. Barkema and Drabenstott (1995) raised the role of information technology, suggesting that as technology developed, allowing firms to more readily manage a wide range of activities, internal co-ordination would be more favourable. However, they also noted that technology improving market information systems can favour external co-ordination by making previously complex transactions routine.

Table 4.1: Transaction characteristics with matching governance structures. Adapted from Williamson (1979).

		Asset Specificity		
		Non-Specific	Mixed Specificity	Highly Specific
Frequency	Occasional	Market	Co-operation – Third Party (Neoclassical	Relationship Management Contracting)
	Recurrent	(Classical Contracting)	Co-operation (Relational	Integration Contracting)

In line with Williamson (1979), Barkema and Drabenstott (1995) emphasised the encouragement asset specificity gives to co-ordinating activities internally. Investments in specialised assets increase the risk associated with unexpected market outcomes — price, quantity, quality and timeliness, and the threat of opportunism (Williamson, 1979). Internal co-ordination reduces this risk by placing the uncontrollable market factors within the administrative structure of the firm. Barkema and Drabenstott (1995) went on to suggest that internal co-ordination is better suited to targeting smaller consumer niches, as firms can take advantage of economies of scale, and minimise the risk associated with investment in specialised technology.

Recent researchers have redefined Richardson's (1972) continuum of co-ordination — the method of co-ordination can be defined with respect to the extent of integration between businesses (Blackmur, 1990; Barkema & Drabenstott, 1995; Gerybadze, 1995). However, Peterson and Wysocki (1998) used another term more similar to Richardson's: "The Vertical Co-ordination Continuum". They defined five vertical co-ordination strategies: spot market, specification contract, strategic alliance, formal co-operation, and vertical integration (i.e., there are three distinct co-operative co-ordination strategies). Peterson and Wysocki (1998) defined the strategic options for vertical co-ordination not in terms of the degree of integration, but the extent to which the co-ordination strategy exhibited Adam Smith's [10] "Invisible Hand" or "Managed" characteristics (Figure 4.1). Other researchers (e.g., Yoshino and Rangan, 1995) have also identified three co-operative co-ordination structures: joint ventures, equity alliances, and non-equity alliances/non-traditional contracts. These co-ordination structures are comparable to Peterson and Wysocki's co-ordination strategies. However, Yoshino and Rangan's definitions are too narrow, as will be explained below.

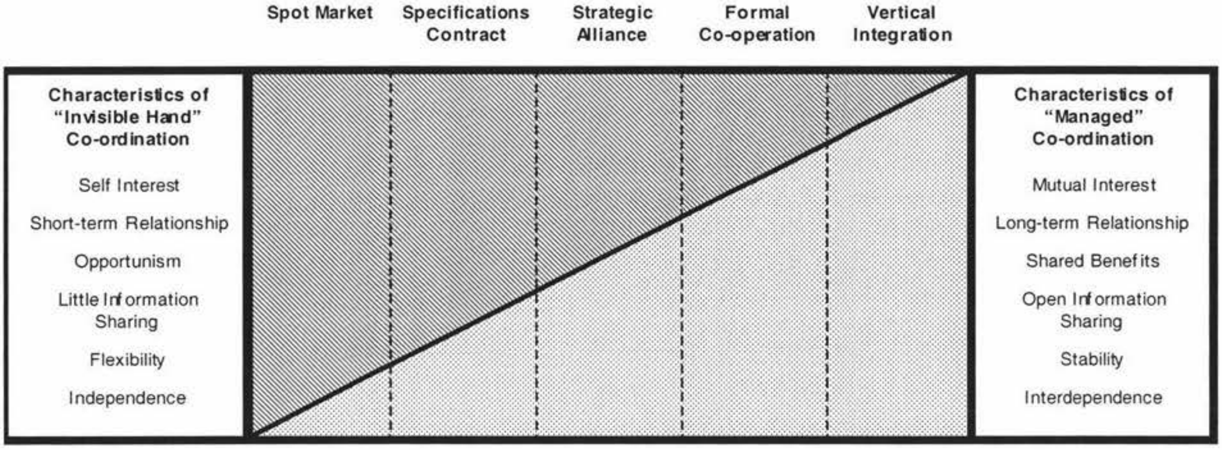

Figure 4.1: The vertical co-ordination continuum: strategic options for vertical co-ordination. The diagonal line represents the mix of invisible hand and managed co-ordination characteristics found in each of the five alternative vertical co-ordination strategies (the area above the line indicates the relative level of invisible hand characteristics and the area below indicates the relative level of managed characteristics (Peterson and Wysocki, 1998).

Peterson and Wysocki's (1998) strategic options can still be considered to fit within Richardson (1972) and Gerydaze's (1995) three broad categories, but with more detailed definition of the co-operative solution options. However, the reason for a greater number of co-operative strategies being defined is the intensity and nature of control employed by the various co-ordination strategies. Strategies on the left of Figure 4.1 have low intensities of control while strategies on the right side involve high intensity of control.

[10] Adam Smith discussed the pursuit of self-interest by firms and invisible hand co-ordination of firms in his book "The Wealth of Nations" (1776).

Even though Peterson and Wysocki (1998) provide a more comprehensive view of the continuum, the three broad categories of market, integration, and co-operation will be used to structure this chapter.

Before reviewing the three broad co-ordination strategies, it is appropriate to look at what firms do. Richardson (1972) in his discussion of "The Organisation of Industry" suggested that industry be thought of as carrying out an infinite number of activities (e.g., estimation of future wants, research and development, physical transformation, marketing). Firms with the appropriate capabilities of knowledge, experience and skills, carry out these activities. Activities requiring the same capability for their undertaking are similar activities. Richardson contended that firms tend to specialise in activities for which their capabilities offer a comparative advantage, thus their activities tend to be similar, but noted that this is not necessarily the case.

Activities carried out by firms may be complementary. Complementary activities are related to each other by being a step in a process (e.g., production process) and require coordinating in some way (Richardson, 1972). Similar activities are not complementary activities. For example, production of wool is complementary to the manufacture of blankets, but is in no way similar. This is the prime reason why co-operation occurs — firms need to closely coordinate complementary but dissimilar activities. This co-ordination cannot be left entirely to integration within firms because the activities are dissimilar. Likewise this co-ordination cannot be left to market forces in that it does not require the balancing of total supply of a good or service with the total demand for that good or service, but rather the matching with respect to quantity and quality of individual firm plans (Richardson, 1972).

4.1.1 Market

The market is the classic non-specific governance structure within which *"faceless buyers and sellers ... meet ... for an instant to exchange standardised goods at equilibrium prices"* (Ben-Porath, 1978, cited in Williamson, 1979). Such pure market transactions are isolated acts of purchase or sale where neither the buyer nor the seller accept any obligation with respect to their future conduct, and no continuing association exists or is expected to occur (Richardson, 1972). These interactions are between autonomous, legally independent agents, with free choice to select other market participants (Gerybadze, 1995).

MacMillan and Farmer (1979) suggested that a relationship between buyers and sellers is always a market solution relationship regardless of how close the relationship is or how long it has endured. If better terms of quality, quantity, timing or price can be obtained elsewhere, there is no tie to stop either participant from making alternative arrangements. This opinion is the opposite to that of most other researchers, although their point regarding alternative arrangements is valid, provided the cost[11] of walking away from the current deal or investment is acceptable. It is likely to be better to abandon a poorly performing relationship and seek a new relationship, than to persist with that poorly performing relationship.

Pure market transactions are most readily found in organised financial markets with the trade of stocks and securities. Richardson (1972) suggested that genuine market transactions are uncommon. However, most livestock and unprocessed livestock product transactions throughout the world occur on the openly adversarial commodity or 'spot market' (Palmer, 1996; Fearne, 1998; O'Keeffe, 1998a). Other forms of the market solution exist, such as long-term contracts or networks (Gerybadze, 1995). These involve transactions that are more frequent, negotiations that are less confrontational, and greater information transfer. Control is limited to engaging in price discovery and making a decision on whether or not to enter into the transaction (ex ante control). Ex post control is the decision to repeat the transaction in the future should such a transaction be required (Peterson and Wysocki, 1998).

The market solution ensures that there is a degree of cost discipline (MacMillan and Farmer, 1979). This results in lower direct costs to the buyer (in the case of livestock in China, the buyer may be a trader, a restaurant, or another farmer), providing the opportunity for higher profit margins for that buyer. Livestock markets tend to be highly volatile (the turbulent field of Emery and Trist (1965)) with the price and supply often driven by factors unrelated to the final value of the meat or other product, such as climate and feed supply. However, there may be an annual price cycle related to consumer preferences, beliefs, or traditions, as in China. For example, in Yunnan

[11] Cost here should be taken to mean intangible costs such as reputation and relationship building expenses together with tangible costs such as the loss of investment capital. These costs are termed "switching costs".

Province, sheep meat is usually only eaten in autumn because at other times of the year the sheep are thought to be too thin.

Conditions necessary for smooth functioning of the market solution (Williamson, 1979; Harrigan, 1983; Gerybadze, 1995) include the following (an example of each condition is provided in the context of the New Zealand meat industry):

(i) A high number of customers providing bargaining power. For example, finishing farmers or butchers buying stock livestock at auction. However, the level of bargaining power is dependent upon the amount of pasture on farms, which influences both the number of animals for sale and the demand for animals.

(ii) A high number of suppliers providing competition and more standardised transactions. There are many farmers selling finished livestock to meat processors, and such transactions are highly standardised.

(iii) A highly volatile industry. The volatility of lamb and beef prices is well known.

(iv) Predominantly occasional transactions. Most farmers are not supplying other farmers or meat processors with livestock with high frequency.

(v) Little resource complementarity (resource complementarity does exist both between breeding and finishing farms and between finishing farms and meat processors, so this condition is not met).

(vi) Low entry and exit costs. For farmers, the entry/exit costs are low — the shift between sheep and beef does not require significant investment. However, meat processing has considerable entry costs.

(vii) Short time to entry or exit. The time for farmers to change from beef to sheep or vice versa is very short, just the time between stock sales;

(viii) Readily replaceable resources. Most farm resources such as land are readily traded on a market. However, management is not readily replaceable.

(ix) Low transaction costs. Transaction costs include commission plus transport and a sale yard fee. However, during droughts, because the transport has to be paid, the option to sell livestock at another time is excluded, effectively raising the cost of the transaction; and

(x) Little benefit expected from collaboration. Farmer and meat processor opinion is shifting towards favouring collaboration as its benefits become more understood.

Many of these factors were considered by Coase (1937) to define the boundary of the firm as they are related to the cost of organising the transaction either internally or externally. However, Williamson (1979) noted that as uncertainty increased, obligational market contracts would cease to be used for recurrent transactions with mixed investment features. He suggested that such transactions either would be standardised and moved to a pure market approach, or be internalised. A balance of resources between agents is not required for a successful market transaction (Gerybadze, 1995). The market solution is the most appropriate method of co-ordination in an industry where a knowledge base can be protected (Gerybadze, 1995), such as in restaurants where culinary secrets are not disclosed, or in a declining industry (Harrigan, 1983).

4.1.2 Co-operation

The essence of co-operative arrangements is that the parties to them accept some degree of obligation, and therefore give some degree of assurance as to their future behaviour (Richardson, 1972). Gerybadze (1995) extended this definition to require the firms to be independent and to commit resources to some collaborative activity directed at achieving some common target. Thus, co-operation between two or more parties involves: obligation and assurance; commitment of resources; and a common objective.

Co-operation can take many forms, such as long-term market contracts or joint ownership of a specific venture (e.g., research and development project); all of which can be considered quasi-integration or hybrid co-ordination (Richardson, 1972; Williamson, 1979; Harrigan, 1983; Frank and Henderson, 1992; Gerybadze, 1995). Such collaborative activities can be built on a handshake, a written contract, or be more formal with the establishment of a joint venture. Fearne (1998) noted that collaborative activities are seen by some farmers as a compromise between market organisation and complete vertical integration; and by others still (e.g., independent-minded agriculturalists) as an alternative, less rigid way of co-ordinating the market. Gerybadze (1995) suggested that the market solution becomes a co-operative solution when there is a build-up of both informal ties (e.g., trust) and formal ties (e.g., more binding contracts). Trust and control are discussed in more detail in Section 4.4.1.

Continuing along Peterson and Wysocki's (1998) vertical co-ordination strategy continuum, the three strategies categorised as co-operative strategies are specification contracting, strategic alliances, and formal co-operation.

4.1.2.1 Contracting

Contracts are legally enforceable specific and detailed conditions of exchange. The two parties agree on the conditions of exchange before entering the contract, which requires the parties to invest time and effort in negotiations to provide ex ante control (Peterson and Wysocki, 1998). One party agrees to supply a product with specified characteristics and the other party agrees to buy the product at a specified price. The supplier devolves control over some aspects of production and/or marketing in return for greater certainty over market and input access (Hobbs and Young, 2000). Ex post control is exercised through monitoring of contract execution, and the decision to renew or renegotiate the contract, or to involve a third party to resolve any conflict (Peterson and Wysocki, 1998) (Table 4.2).

Contracts can be classified into three broad types (Hobbs and Young, 2000):

(i) Market-specification contracts – buyer provides a market for a seller's output with the assumption of sale time control and possibly some risk by the buyer. The farmer retains control of the production process.

(ii) Production-management contracts – the buyer has more control over production practices and input usage, though control may be limited to monitoring.

(iii) Resource-providing contracts – buyers exert almost complete control. The buyer provides the market, supervises production, and supplies key inputs, but assumes a much greater proportion of the risk. In some cases, the buyer may retain ownership of the product, so the farmer is effectively paid a management fee and land rental.

Table 4.2: Characteristics of control intensity across the vertical co-ordination continuum (Peterson and Wysocki, 1998).

	Spot Market	Specification Contract	Strategic Alliance	Formal Co-operation	Vertical Integration
Intensity of Control	Low (ex ante dominant)	Moderately low (ex ante dominant)	Moderate (mixed ex ante/ex post)	Moderately high (ex post dominant)	High (ex post dominant)
Focus of Control	Immediate transaction	Contract terms	Relationship	Property rights of stakeholders in limited joint entity	Property rights of stakeholders in full entity
Ex Ante Control Process	Price discovery Yes/no decision to transact	Setting specifications Setting rewards	Building relationship Setting informal parameters	Negotiating formal decentralised ex post governance structure	Negotiating formal centralised ex post governance structure
Ex Post Control Process	Yes/no decision to repeat transaction	Decision to renew/revise contract, involve third party	Mutual resolution or dissolution	Execution of governance policies and procedures in the limited entity	Execution of governance policies and procedures in the full entity

These last two contract forms are becoming increasingly common as agriculture becomes more industrialised and specialised to better meet customer demands (Boehlje et al., 1999).

4.1.2.2 Strategic alliances

The third stage along the continuum is the strategic alliance or exchange relationship. Strategic alliances are co-operative business activities between two or more firms directed at a specific, mutual objective through a specific project, and the partnering firms share both risks and benefits. Strategic alliances do not create independent business entities (Lynch, 1989; Lewis, 1990; Gerybadze, 1995; Underhill, 1996). Co-ordination of strategic alliances is derived from mutual control, and the partners must find their own way to resolve differences and concerns (Peterson and Wysocki, 1998). Conflict resolution is discussed further in Section 4.4.2.

The focus of control is the relationship between the two partners, and the immediate transaction is only one element of that relationship. Relationship building, ensuring mutual interests exist and that the relationship is of a long-term nature, and setting informal parameters for judging the relationship's success and effectiveness are core components of the ex ante control process. Ex post, monitoring of the relationship and transaction performance is essential, and in the case where performance is considered unsatisfactory, mutual dispute resolution must occur. The informal nature of strategic alliances means that third parties cannot often be brought in to assist in dispute resolution (Mohr and Spekman, 1994; Peterson and Wysocki, 1998). Successful alliances require significant amounts of time and commitment to be expended, particularly in ex ante and ex post control processes.

To overcome the informal nature, many strategic alliances involve contracts. These contracts do not constitute the basis of the relationship exchange, but are fallback positions or safety nets (Peterson and Wysocki, 1998).

4.1.2.3 Formal co-operation

The formal co-operation strategy includes many forms of organisational structure including joint ventures, the Japanese keiretsu systems, and agricultural co-operatives all of which require some level of equity commitment (either cash, effort, or emotional), between the partners. The identifying feature of these organisational structures is the creation of an independent business entity (Lynch, 1989), which is the centre of control. Control, by being an independent business entity, is still decentralised from the owning partners. The partners first establish policies and procedures as to conduct, and the contribution of equity to the venture makes defining property and decision rights and responsibilities clearer than for strategic alliances providing ex ante control (Peterson and Wysocki, 1998).

Co-operation does not require a firm to be involved across the entire business of a partnering firm — unlike a merger, acquisition, or internalisation, a collaborative activity only has to mesh together those parts of each firm's culture and operations that work well (i.e., there is no need to purchase the poorly performing division of the other firm) (Lewis, 1990). However, there is a growing belief that partner firms, buyers, suppliers or alliance partners, can both restrict and enlarge the opportunity set or future relationships for a firm (Gulati et al., 2000). Poor partner reputation in the industry with respect to relationships with other firms could impact on the firm's own reputation and their relationships with other firms. A supplier's capability may also influence the performance of the firm, and this capability may be eroded or enhanced by technological change (Afuah, 2000). An example could be two supermarkets that had co-operative relationships with two separate meat processors; the supermarket supplied by the meat processor first adopting vacuum packaging and chilling technologies would perform better than the supermarket supplied by the meat processor continuing to use frozen meat technology.

Ex post control is exercised through owner monitoring of venture performance, adjusting policies and procedures as deemed necessary. In extreme situations partners can walk away from the venture as suggested by MacMillan and Farmer (1979) because they have retained their autonomy. However, the ability to do so is significantly reduced by the investment partners make (Peterson and Wysocki, 1998).

Co-operatives[12], a form of formal co-operation, are of particular interest because they are such a common form of vertical integration in agriculture. An agricultural co-operative is an organisation owned and controlled by producers to create a new entity through horizontal partnerships enabling farmers to vertically integrate (Fearne, 1998; Rebelo et al., 1998). Co-operatives are established to either project their members forward (marketing co-operatives, e.g., dairy co-ops that dominate New Zealand and The Netherlands' dairy industries), or backward (purchasing co-operatives, e.g., Farmlands and Ravensdown in New Zealand). The purpose for forming co-operatives is to provide bargaining strength in dealings with major buyers and sellers, to create economies of scale and to mitigate market uncertainty (Fearne, 1998; Rebelo et al., 1998).

Co-operatives are becoming popular again as producers grapple to overcome the new challenges consumers face them with. These new co-operatives have been termed New Generation Co-operatives (Harris et al., 1997; Stefanson and Fulton, 1997). New generation co-operatives are producer owned, have restricted membership, and process members' products. Membership entails the purchase of

[12] The term co-operative in this sense is perhaps unfortunate, and is simply a reflection that such entities existed long before the recent study of co-operative co-ordination of firms

delivery-right shares — which differentiates them from traditional co-operatives — to meet capital requirements, provide a feeling of ownership to individual producers, maintain low debt levels, and promote member commitment. Producers enter into delivery contracts with the co-operative. The delivery contract specifies quality and production standards, and the volume of output to be supplied. Producers usually do not have sufficient equity to fund the co-operative, so raise the remaining equity through debt and the issue of preferred shares (non-voting shares) (Harris et al., 1997; Stefanson and Fulton, 1997).

4.1.3 Integration

Integration is a strategy allowing firms to increase control in an industry through ownership (Porter, 1980; Grossman & Hart, 1986; Gerybadze, 1995; David, 1997). Firms may integrate horizontally or vertically (Dobson and Starkey, 1990). The former is a strategy by which firms seek greater control over competitors. The latter allows greater control over distributors/retailers (forward integration) or suppliers (backward integration) (David, 1997). Vertical integration is the final strategy along the vertical co-ordination continuum (Peterson and Wysocki, 1998).

4.1.3.1 Horizontal integration

Horizontal integration is the process of enlarging a firm's role in a specific step within an industry or process, thus increasing the firm's control over competitors. The firm is not becoming involved in new activities[13], just more of the same (Buckley and Michie, 1996). This increased involvement could be brought about through acquisition, merger, or take-over.

The potential advantage of horizontal integration is the increased economies of scale: elimination of duplicated facilities and greater transaction efficiencies (David, 1997). A further advantage is the ability to increase market share. Richardson (1972) noted that firms would find it expedient to concentrate on similar activities during any expansion phase, because this is where core capabilities lie, a sentiment echoed by Prahalad and Hamel (1990).

[13] Conglomerate diversification – controlling unrelated businesses

Horizontal integration is an effective strategy when an organisation can gain monopolistic characteristics in a sector without facing anti-competitive charges (Blackmur, 1990). This requires that the firm's industry is growing, economies of scale provide competitive advantages, the firm has sufficient human and capital resources to effectively manage an expanded business, and competitors lack these resources (David, 1997). This strategy is not appropriate if the industry is declining and the firm does not have the necessary resources for an effective expansion. Contrary to this, horizontal mergers have occurred between firms that were former competitors, providing substitute goods and services during decline in order to lower fixed costs on a unit basis, taking advantage of economies of scale, and maintaining profitability at previous levels (Shadbolt *pers. comm.*, 1998). The reason for merging is to become the industry leader, either through being significantly larger than non-merging competitors offering the above mentioned benefits (Pepall et al., 1999), or by combining expertise and production processes (Dobson and Starkey, 1990).

4.1.3.2 Vertical integration

Vertical integration is the creation of one firm that has control over all aspects of the transaction (Peterson and Wysocki, 1998). It is a means by which businesses have greater control over business and financial risks, and manage vertical relationships in order to maintain a ready supply of inputs and a ready market for outputs. Vertical integration is an internalisation of activities and is sometimes termed a hierarchy (Williamson, 1979; Blackmur, 1990; Barkema & Drabenstott, 1995; Gerybadze, 1995; David, 1997). Vertical integration results in the two parties to a transaction becoming one firm, and can be achieved through a merger, an acquisition, or through one party committing resources to replace the market function of the other party. Control becomes centralised, with all decisions being made within the one firm and all the property rights being held by that one firm (Peterson and Wysocki, 1998). The expanded scope of the firm, and the difficulty in re-separating, increases the complexity and intensity of the control function. Ex ante, the control process involves negotiating the formal centralised ex post vertical co-ordination strategy. Ex post, control results from effective execution of governance policies and procedures for the integrated firm (Peterson and Wysocki, 1998).

Harrigan (1983) described four determinants of how vertically integrated a business is.

(i) *Breadth* – the activities a business might perform in house (e.g., the production of sheep and beef cattle on the same farm are different activities);

(ii) *Stages* – steps within each separate activity that need to be carried out (e.g., the breeding and finishing of cattle are two stages in the production of beef);

(iii) *Degree* – the amount of each activity that occurs in house (e.g., a lamb finisher may breed some lambs and buy other lambs in the market); and

(iv) *Form* – the ownership structure (e.g., the firm that processes meat may be owned by many farmers, such as meat processing co-operatives in New Zealand).

The benefits of vertical integration can have either a direct or an indirect impact upon the profitability of the firm. Internal benefits or costs have a direct influence on the profitability of the strategy, while changes in the competitive posture of the firm have an indirect influence (Harrigan, 1983).

Internal benefits could include a reduction in costs via lower overheads and fewer steps in the production or distribution processes (economies of integration); or less time spent 'price shopping' and communicating or negotiating with customers and suppliers (Blois, 1972).

The advantages in terms of the competitive posture of the business include (Blois, 1972; Harrigan, 1983; Blackmur, 1990; Lawrence et al., 1997; Pepall et al., 1999):

(i) Improved information, i.e., technological and marketing intelligence;

(ii) Greater control of the environment in which the business functions — this can also be a defensive strategy against other businesses;

(iii) Decision making is centralised, allowing decisions to be made more rapidly and ensuring a common strategy for each activity;

(iv) The potential to differentiate products more readily, making it more difficult for competitors to replicate products, which may increase the barriers to entry, and thus, exclude potential rivals;

(v) Lower levels of uncertainty as the ability to forecast costs and demands within the firm increases;

(vi) The firm can guarantee internal supply, which strengthens it against opportunistic firms; and

(vii) Common ownership of production stages can lead to more efficient technological adaptations and innovations.

(viii) Vertical integration is an appropriate strategy in situations where (Harrigan, 1983):

(ix) Present suppliers/distributors/buyers are expensive, unreliable, or incapable of meeting the firm's needs;

(x) The firm has little bargaining power — there are few suppliers/buyers and many competitors;

(xi) The industry is well established or growing rapidly;

(xii) Production and price stability and predictability offer competitive advantages; or

(xiii) The sector being considered has high profit margins.

Integration is successful when firms are involved in repetitive tasks and frequent transactions, using complementary and scarce resources in an industry, and have similar goals. Such integration would most likely involve a vertical merger. It is preferable for the industry to be relatively stable for the integrated firm to exploit the transaction-cost savings and to ensure it is not outrun by competitors with respect to technology advances. Entry and exit costs and times tend to be considerable in highly integrated industries (Harrigan, 1983; Gerybadze, 1995; David, 1997).

There are a number of drawbacks identified by reviewers associated with internal co-ordination. Harrigan (1983) stated that managers and firms need to be cautious in their co-ordination decision as vertical integration does not necessarily lower costs or risk for the firms involved. Blois (1972) noted that integrated firms could suffer from rising internal costs because the various activity-related stages of the firm do not face direct competitive pressure. Competitive advantages could be lost by not being as active in the market (i.e., less aware of changes in industry structure, market and cost movements) meaning the ability to make strategic and tactical adjustments is lost as operations become less flexible (Blois, 1972; Harrigan, 1983). Reduced access to external skills and knowledge may also limit growth of the vertically integrated firm, and the management team may be over-stretched. Vertical integration may actually increase the capital requirements for the firm, or the firm may end up having an excess of assets such as human resources, plant and buildings. Vertical integration also gives rise to the difficulty of balancing the throughput of each sector within the firm if disparities occur between productive capacities at various stages of production, thus raising internal costs (Blois, 1972; Harrigan, 1983; Barkema & Drabenstott, 1995). Specialisation, doing similar activities, is also lost (Blois, 1972). Negative public opinion or government pressure may also impact on the success of the merger (Blois, 1972), which could result in either fewer customers, or regulatory restrictions in operation.

Vertical integration is often seen as a means to move into a better business area, or as a means of attracting more business to their primary section, thus creating work for that core business (Harrigan, 1983). Harrigan (1983) suggested that these were not sound reasons for integrating. As with horizontal integration, the firm must already have access to the human and capital resources necessary to manage the new business effectively (David, 1997). Vertical and horizontal integration are viewed by some firms as a path to obtaining a monopoly within an industry sector (Blackmur, 1990).

Harrigan (1983) suggested that firms need to regularly assess market share and profitability with respect to excess capacity costs, and synergies derived from the integrative structure. Coase (1937) had also suggested that firm boundaries would change often as the relative costs of organising activities internally and externally change.

4.2 Co-ordination of supply chains

In the food and fibre industries, there is a growing realisation that consumer value is not created by individual firms, but rather by groups of firms involved in different stages of the supply chain such as producers, processors, exporters, retailers and input suppliers (Nitschke and O'Keefe, 1997). For example, a New Zealand dairy farmer does not compete directly with an Australian dairy farmer in the Chinese milk powder markets. Rather the system of New Zealand dairy farmers, processors, packagers and marketers competes with a similar system from Australia. The changing market circumstances and characteristics of agricultural food supply chains[14] could justify a shift in the way firms are co-ordinated (den Ouden et al., 1996).

This change in understanding has only recently occurred in the agricultural/food sector (Fearne, 1998), but has been common in other industries like automobile manufacturing, computer supplies, and medicine (Lewis, 1990; Faulkner, 1995; Gerybadze, 1995; Underhill, 1996; Anderson et al., 1997; Stallkamp, 1998). Perhaps the understanding and co-ordination of supply chains (to create value chains) has been mastered best in Japan, where 'moralised trading relationships' between firms performing different stages of a production process have prevailed for many years as the basis of the keiretsu system. These relationships can only be broken after some 'lack of sincerity' rather than because of price disparity (Dore, 1983; Imai and Itami, 1984).

The concept of supply chain management is a new phenomenon based on the notion of co-operating to compete, recognising that the focus of competition has

[14] Supply chains are defined here as all the firms operating to transform raw material or commodities into goods purchased by consumers. A supply chain does not necessarily involve close linkages between chain participants, and firms do not necessarily appreciate the concept of competing as a chain. However, a supply chain that does appreciate the market circumstances, co-operatively manages supply, establishes vertical linkages between firms, and is focused on competing as a chain and creating value for their customers, is defined as a "value chain". Supply chains have always existed, but the co-operative management of supply chains to form value chains is a relatively new idea.

shifted from firm versus firm to chain versus chain. Supply chain management is about co-operatively co-ordinating activities between complementary firms to transform raw material to the final product that the ultimate consumer needs or wants, by adding value (Anderson et al., 1997; O'Keefe, 1998b; Spekman et al., 1998; Blackwell and Blackwell, 1999). The purpose of supply chain management has also shifted from leveraging the lowest initial purchase price (e.g., Underhill, 1996), to leveraging skills, expertise and capabilities of the co-operating firms (Prahalad and Hamel, 1990; Ralf et al., 1995; Spekman et al., 1998).

Supply chain management brings together ideas and perspectives from a diverse range of economic organisation theories (O'Keefe, 1998a):

(i) Transaction cost economics – suggests that the primary concern of management is the efficient organisation of activities with a focus on the cost of organising transactions internally or externally. However, transaction cost economics highlights the importance of undertaking specific investments for the development of closer relationships and the threat of opportunism (Williamson, 1979), as the redeployment of these assets to alternative uses is costly (Williamson, 1991). Transaction cost economics also highlights the key roles that uncertainty and the availability of information play in the establishment of closer inter-firm ties.

(ii) Agency theory – focuses on the delegation of responsibility from principal to agent. Agents will be self-interested, pursuing their own goals, unless induced to do otherwise. Thus, firms must monitor and control the behaviour of their agents, either at a cost or through incentives to refocus the agent's goals towards the principal's goals (Eisenhardt, 1989a) (e.g., forcing the agent to take an equity position). Such incentives are offered in co-operative partnerships — rewards are largely based on own input to the partnership.

(iii) Resource based view – focuses on the valuable, rare, and imperfectly imitable resources or capabilities (i.e., strategic assets), and how to best capitalise on these to create a competitive advantage (Peteraf, 1993). This provides the rationale for forming relationships between firms with advantages by grouping more advantages together — the time required to obtain strategic resources by more traditional means (e.g., managerial services via hiring and training) can act as a brake to growth (Penrose, 1959).

(iv) Business-to-business relationship theory – emphasises the importance of compatible goals, value creation, and commitment (O'Keefe, 1998a).

Supply chains can be co-ordinated using any of the three broad methods — market transactions, co-operative relationships, and integration of activities, or a combination of all three. However, the type of good or service being supplied partially determines the suitability of the co-ordination mechanism. This becomes obvious once the four theories of industry organisation outlined above are brought together. For example, an auction system is quite appropriate for commodity products, but is inappropriate for differentiated products or for implementing segmented marketing strategies (Nitschke and O'Keefe, 1997; Hobbs and Young, 2000), because of the new product characteristics.

4.2.1 Commodity product strategies

O'Keefe (1998a) suggested that in commodity markets, the sum of value created along the supply chain is fixed, but, there is some variation due to changes in supply and demand. Therefore, the main co-ordination function in commodity markets is to allocate the share of value among the different chain participants. This is clearly a win-lose game, with gains made by one participant at the expense of other participants, leading to adversarial relationships between supply chain participants (Ashkenas et al., 1995; Palmer, 1996; Fearne, 1998; O'Keefe, 1998a). Apart from the obvious size imbalance between individual producers and processors, which impacts on the stability of relationships between them, why do producers continue to prefer the spot market or the auction system to more co-operative marketing strategies? The answer lies in the value farmers place on independence and the reluctance to relinquish even some degree of control, especially to another party with whom they have traditionally had an adversarial relationship. Perhaps farmers selling livestock feel the risk of poor invisible quality (e.g., pleurisy, arthritis, and fat depth in lambs) is too high for them (they would be penalised by a processor with or without a contract) (Fearne, 1998; Hobbs and Young, 2000), and they believe they can minimise the variation in possible returns for any one transaction. This is an example of farmer opportunism. The other possible explanation is that some farmers believe the chance that they will get a higher price on the spot market than with a contracted price is a worthwhile risk as this maximises the upside *and downside* variation in possible outcomes. Such beliefs are more likely in farmers with a gambler instinct and a belief that they can control outcomes more than they really can (Olsson, 1988; Kaine et al., 1994). Nitschke and O'Keefe (1997) reported that farmers appreciated that, when they used the auction system, both their independence and risk were maximised. Farmers participating in auction systems do not receive specific customer feedback because pure market transactions do not involve any obligation with respect to future conduct and are isolated from the rest of the food chain because of this lack of feedback (Palmer, 1996; Nitschke and O'Keefe, 1997).

Commodities can be almost entirely uniform, with very little to differentiate between the products supplied by two separate firms. In such a situation, the key to a firm differentiating its product against the product of a similar firm, is price. Being the lowest priced supplier of a commodity will largely ensure market share, because price is the only differentiating factor (i.e., Porter's (1985) cost leadership strategy).

Because agriculture is a biological system, supply can be highly uncertain, and, in the case of pastoral based systems, supply can be highly seasonal. Conversely, demand is usually relatively constant, although sometimes annual price cycles exist that are associated with consumer preferences, beliefs, or traditions (e.g., as noted previously with respect to sheep meat consumption in China). Consumer demand is not normally related to producer supply, raising the problems of processing capacity, storage, and distribution of agricultural goods, as highlighted by Sheppard (1982) and Fearne (1998). Such problems are of enormous proportions in China's food supply chains (Crook, 1997; Tuan and Ke, 1999).

Producer price is strongly correlated to the balance of producer supply and ultimate consumer demand, leading to seasonal producer price patterns because many ultimate consumers are inelastic in their demand, can be price sensitive and unwilling to pay for the privilege of eating a product out of season. This leaves producers to carry the cost of the extra infrastructual capacity required to ensure constant supply essential for maintaining market access. This is probably not unreasonable in that returns in any supply chain should be apportioned on the basis of value-added, as higher returns must be justified by increased value-added (Fearne, 1998). However, consumer price sensitivity is declining in many markets as incomes rise, increasing the value that can be captured from more affluent consumers (Boehlje et al., 1998), potentially allowing an easing of producer burdens.

The allocation of returns in commodity supply chains is almost entirely determined by those participants with the most important or least substitutable resources (i.e., large processing firms, and, more recently supermarket chains), as they wield the most power, meaning that the degree to which producers can benefit from reduced consumer price sensitivity is in other, larger hands (retailer and processor opportunism). Boehlje et al. (1998) suggested that the owner of the least substitutable resources has a significant impact on what the chain actually does or does not do. These resources have traditionally been capital and labour, and are able to generate the lowest cost along the supply chain. However, as noted above, this situation is changing.

4.2.2 Differentiated and focused product strategies

As noted in Chapter 2, food demand is changing from a mass commodity market to a widening array of niche markets within which consumers demand healthy, convenient, and nutritious food products (Barkema and Drabenstott, 1995; Royer, 1995). Many consumers are also becoming increasingly concerned with production methods, animal welfare, and environmental pollution, requiring supply chains to be able to trace products and verify practices used (den Ouden et al., 1996), adding a further dimension to differentiation opportunities.

Taylor (1997) suggested that the challenge for New Zealand food producers is to cater for a growing number of consumers with rising incomes who are increasingly demanding higher quality and more diverse food products. This challenge is by no means an exclusive opportunity for New Zealand farmers — such demands are being felt by market-participating farmers worldwide. In fact, this challenge is not even exclusively directed at farmers, but rather at food supply chains and all the participants of those chains. This challenge almost entirely destroys the rationality of maintaining the lowest cost of production because product quality is likely to be negatively correlated to cost of production, especially for those farmers with access to these differentiated product-loving markets. However, a degree of cost control is required to remain competitive and profitable, because the majority of consumers are still price sensitive.

In order for food supply chains to meet this challenge, each participant in the supply chain needs to be provided with their inputs in the correct quantity, with all the requested product characteristics (e.g., weight, composition, quality — both visible and invisible), at the required time and at the right cost, by the preceding supply chain participant (Anderson et al., 1997). For the preceding supply chain participant to be able to meet these criteria, they must have information detailing each requirement at such a time that enables them to produce to those specifications (Palmer, 1996; Anderson et al., 1997 Fearne, 1998; Spekman et al., 1998; Blackwell and Blackwell, 1999; Lee, 2000). Central to the provision of timely information is an understanding of the business activities of other supply chain participants. Such understanding requires firms to share their *knowledge* rather than just *information* (Lee, 2000). This is especially important for producers operating biological systems due to the long action/outcome time lag requiring a correspondingly long lead-time.

The source of power in differentiated product supply chains shifts from being the physical and financial resources held by the large firms in commodity supply chains, to knowledge and information. This knowledge can be categorised as either knowledge of consumer wants or knowledge of how to produce those attributes desired by the consumer. Information about what consumers want, and on how to produce goods to meet consumer specifications, is unique and provides power to those participants holding that knowledge (Boehlje et al., 1998). Attribute production know-how is largely held by genetics or processing companies, because these technologies are most readily protected. In contrast, farm level production technologies are readily spread about the farming community, leaving the only differentiating factor between farmers to be their managerial skill, motivation, access to necessary inputs and information, and the availability of resources to implement technologies in order to produce to specification. However, such unequal distribution of power does little to build lasting relationships with intermediatary supply chain participants (Nitschke and O'Keffe, 1997; Fearne, 1998). Information on what to produce is largely held by processors and supermarkets (Boehlje et al., 1998).

4.3 Co-ordination of value chains

Food industry value chains are "managed" supply chains, i.e., supply chains in which participants co-operate with each other. Value chain participants forge co-operative relationships with partners rather than continuing adversarial fights for margins, as is common in traditional supply chains. Some researchers have called these new value chains "demand chains" because of their focus on consumer demands (e.g., Blackwell and Blackwell, 1999).

4.3.1 Motives for the creation of value chains

Proponents of supply chain management have offered a multitude of reasons why firms should link up with other supply chain participants and vertically co-operate, such as economies of scale, cost reduction, sharing of capital and resources, risk sharing, technology and information transfer, operating synergies, overcoming barriers to entrance, and increasing rewards (e.g., Lynch, 1989; Lewis, 1990; Gerybadze,1995; Underhill, 1996). However, there are only three broad motives for establishing stronger links with other supply chain participants and creating a value chain. There is a common purpose to each motive though, and that is to capture value.

(i) The first motive is directed at leveraging assets, capabilities or inputs, particularly strategic assets and capabilities (rare, valuable, imperfectly imitable and complementary), and ensuring supply. The focus of this motive is on improving efficiency and controlling costs, including transaction and agency costs, and maximising capacity utilisation.

(ii) The second motive is the attainment of a more appropriate risk-return profile. As firms make investments in specific assets they become less flexible, thus certainty becomes more important for them. All firms are exposed to risk at the buyer-seller or transaction interface. Buying firms face uncertainty as to product quality, reliability of the quantity and timeliness of supply, and product price. Selling firms face price uncertainty and buyer or market access uncertainty (Hobbs and Young, 2000). Another two risks faced by the entire food supply chain are safety and health of the food products and the risk of damaging the environment (Boehlje et al., 1998). Minimising these risks requires supply chains to be able to trace-back products, and co-operation makes such tracing of products easier. Risk is greatest for those participants who have invested in assets or produce specifically for a customer — there are considerable costs associated with investments (Williamson, 1979) and products produced specifically for a customer are worth less in alternative markets (O'Keefe, 1998b)

(iii) The third and central motive is to best match consumer demands as a supply chain and create value. Creating enhanced customer value so that each supply chain participant has the opportunity to capture some of the value added is the long-term solution to ensuring competitiveness and profitability for each member of the supply chain (Nitschke and O'Keefe, 1997), and must be the core focus of any relationship between supply chain participants, because as O'Keefe (1998b) stated "the world is full of cost reduction techniques but sooner or later companies have to create value".

Boehlje et al. (1998) suggested that participating firms progress from motive to motive, and that each motive is a stage through which co-operating firms pass. Although this may be a reflection of reality, the focus should always remain on responding to consumer demand.

The reasons for initially focusing on efficiency, cost reduction and resources, then on risk reduction, and finally on responding to consumers, is the relative ease in capturing value and achieving benefits from these motivations. A further reason is the relative observability and measurability of outcomes derived from each of these motives. Cost reduction opportunities are more readily identified and implemented compared with opportunities for lowering risk. Also, the nature of business risks change as closer relationships are formed — price, quality, and supply risks may be reduced, but other new risks, such as relationship risk to which the firm previously had no or only very little exposure are introduced (Boehlje et al., 1998; O'Keefe, 1998b). Boehlje et al. (1998) further noted that improving responsiveness to consumers, and then measuring that increase in responsiveness, is extremely difficult for two reasons. The first is that consumers may not be consistent in their behaviour, providing ambiguous signals to supply chain participants. The second is that regardless of the accuracy and efficiency of information networks within the food supply chain, the whole system is dependent upon biological production processes, the variation of which makes it difficult for producers to respond as quickly and effectively as desired to consumer signals.

Another reason for first co-operating in cost saving and efficiency measures, and then in more strategic activities, is that it is a low risk means of learning about the co-operating firm, establishing a reputation and building trust, discussed further in Section 4.4.1. It must be remembered that firms initially are not certain of the sincerity of the other firms they trade with, they have been operating predominantly in adversarial circumstances, and this uncertainty is a hurdle to achieving greater co-operation (Fearne, 1998). Even with the marked increase in companies understanding the need for vertical co-operation and the formation of value chains, Spekman et al. (1998) showed that buyers and sellers still maintain different views of the purpose of such organisational co-ordination. They found that buyers tend to focus on the cost saving aspects over the revenue enhancing benefits, while sellers appreciate the revenue enhancing benefits more. This difference in world-view is constraining the establishment of tighter relationships between supply chain participants which leads to the entire supply chain sacrificing customer satisfaction, revenue, and cost effectiveness (Spekman et al., 1998).

4.3.2 Drivers of changes in supply chain co-ordination

Williamson (1979) showed that transaction characteristics affect the type of vertical co-ordination mechanisms firms employ with other supply chain participants. He discussed transaction frequency, uncertainty, and asset specificity as key determinants of governance structures. Hobbs and Young (2000) argued that these transaction characteristics are the result of product characteristics, which are in turn determined by technological, regulatory and consumer preference "drivers" (Figure 4.2).

Consumer preference is the lead driver determining the selection of different vertical co-ordination mechanisms. Products are developed because somebody identifies the opportunity to meet a consumer want, and to create value.

Regulations are established in response to consumer demands. For example, consumers want safe and healthy food, so many governments have introduced food safety acts to make food firms liable in the event of food-borne disease outbreaks.

Food safety regulations have led to compulsory trace-back schemes (e.g., in UK and Canada). However, in some countries these schemes are initiated by farmers themselves, but only in response to consumer wants, or to protect market share and access and prevent the spread of livestock diseases (e.g., New Zealand's compulsory tagging of cattle and deer is intended to trace the sources of TB, and also has the potential to be used for product trace-back by processors, exporters and marketers) (Boehlje et al., 1998; Fearne, 1998; Hobbs and Young, 2000).

Similarly, technologies are developed largely in response to consumer signals. Admittedly, most technologies are developed to tap a latent demand[15], but such innovations are first thought of because the originator believed consumers would prefer products with these new characteristics. Therefore, consumer preference also drives the technology driver of vertical co-ordination characteristics.

A change in product characteristics demanded by the ultimate consumers means the retailer will demand these changes of the supplier, being packager, distributor or processor, who will in turn eventually require farmers to produce livestock with different characteristics. Thus, a change in consumer requirements impacts every participant in the supply chain. This is what makes vertical co-operation so fundamentally important to creating value and maintaining value for every participant in the supply chain, and herein is the purpose of forming value chains.

Product characteristics influence the characteristics of the buyer and seller transactions. New product characteristic requirements may necessitate a supplier to invest in new technology, learn new capabilities, or obtain new resources. There is a cost associated with such investment that must be compensated for with higher returns. As the product characteristics further differentiate the product from the original commodity, there is increased risk associated with the specific asset investment and the production of that good (see Section 4.3.1 above).

[15] Potential and as yet unrecognised demand.

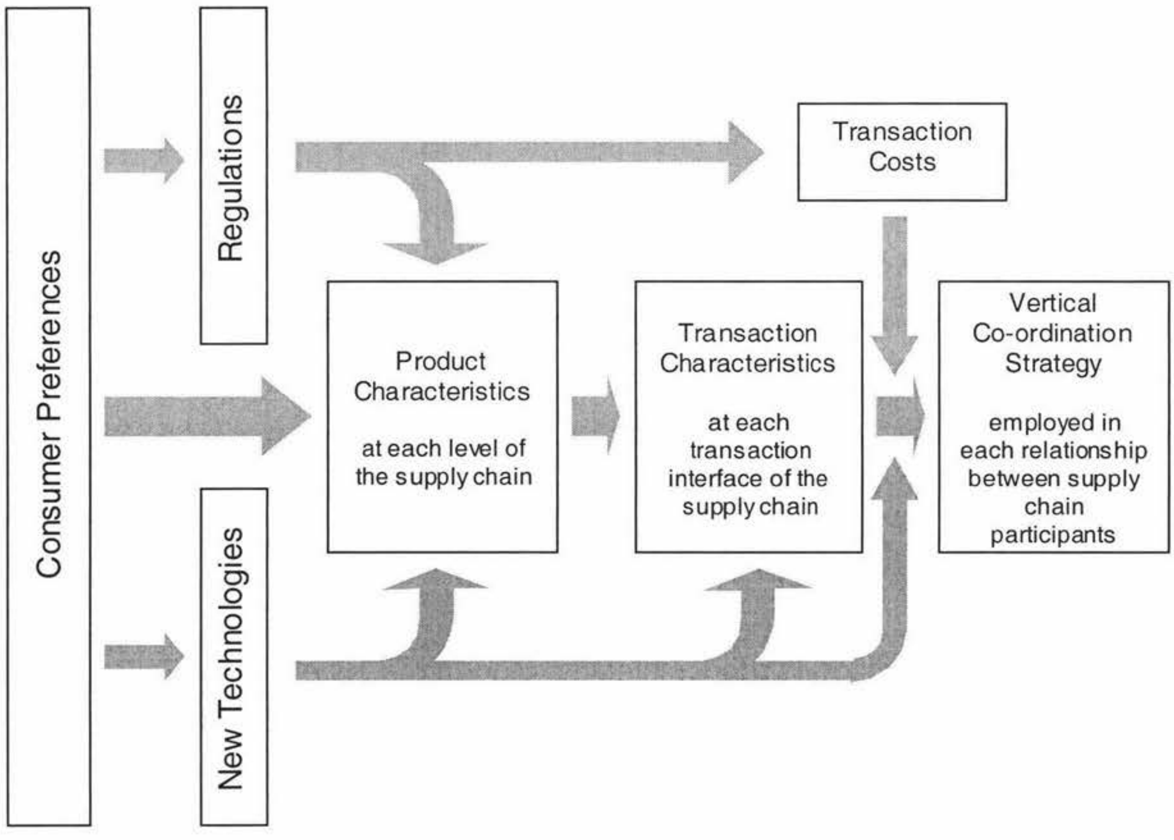

Figure 4.2: Conceptual model of determinants of vertical co-ordination mechanism. Modified from Hobbs and Young (2000).

Transaction characteristics are influenced by the product characteristics, especially with respect to uncertainty. Product characteristics, such as being differentiated from other products, and perishability, add uncertainty to both buyers and sellers. Increased risk at transaction interfaces favours more integrative governance structures (Williamson, 1979). As previously noted, customers are demanding fresh food, meaning that products in retail outlets must be renewed and supplied more often, eventually requiring producers to supply the primary product more often. This increase in transaction frequency also influences the suitability of different governance structures and such recurrent transactions are better managed through greater integration or vertical co-operation.

Transaction costs are influenced by both regulations and technology. Regulations could add compliance costs to various participants in the supply chain and make transactions more complex (Hobbs and Young, 2000). This is especially the case with ensuring traceability of food products in the event of a break down in food safety or quality. Ensuring traceability requires livestock tagging and more intensive monitoring (monitoring costs are higher for occasional supply chain relationships than for more frequent transactions or for those transactions occurring within closer supply chain relationships) (Hobbs and Young, 2000). Technology can reduce transaction costs with market information systems that improve the speed of information flow between buyers and sellers, and make complex transactions routine (Barkema and Drabenstott, 1995).

4.4 Value chain management

Value chain relationships evolve over time (Spekman et al., 2000), and the continuation and enhancement of the relationship relies on satisfaction (Zineldin and Jonssan, 2000). Initially, there is no relationship between firms, or only occasional market transactions, so why do firms select other firms to be their partners, and how do firms ensure the relationship provides satisfaction and maintain the relationship?

Firstly, firms enter into partnerships with other firms because of the drivers and motives discussed above (Section 4.3.1), but they choose their partner firm because they are confident that their chosen partner will behave in a satisfactory way, acting truthfully and with commitment (Das and Teng, 1998), and that the partnership will provide satisfaction to the firm (Section 4.4.1). Secondly, in order to maintain a relationship and continue to gain satisfaction from that relationship, the firm itself must act in a satisfactory manner (Kanter, 1994; Mohr and Spekman, 1994; Monczka et al., 1998; MacMillan et al., 2000) (Section 4.4.2).

4.4.1 Establishing value chains

A firm's (Firm A) confidence in another firm (Firm B) is derived from the level of trust Firm A has for Firm B, and the level of control Firm A has over Firm B (Das and Teng, 1998). Trust and control are interrelated factors. The traditional view expressed in the literature was that trust and control had a complementary relationship and that one source of confidence can substitute for the other (Grossman and Hart, 1986; Ring and Van den Ven, 1994; Zaheer and Venkratraman, 1995). However, Das and Teng (1998) suggest that trust and control are supplementary, and that the aggregated levels of trust and control will determine a firm's confidence in partner behaviour (Figure 4.3).

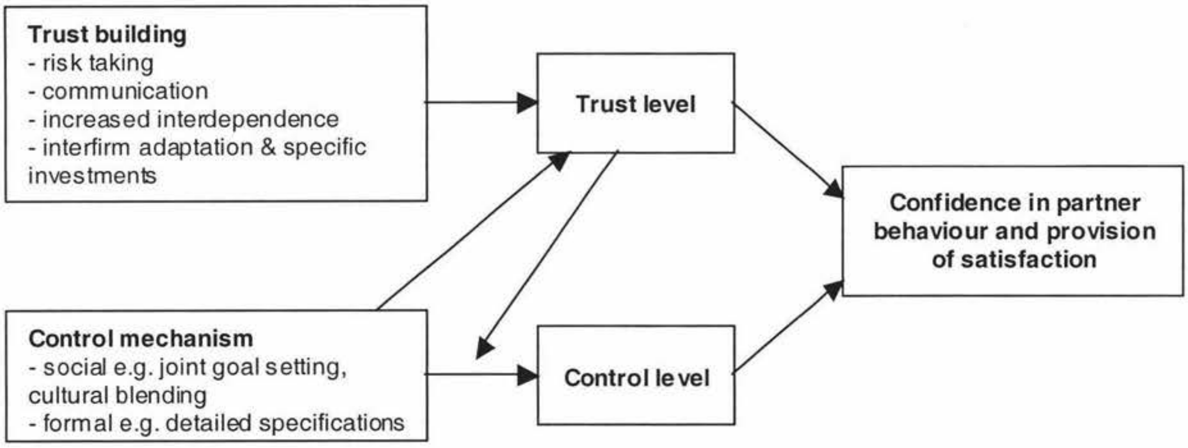

Figure 4.3: Contribution of trust and control to confidence in co-operative relationships. Adapted from Das and Teng (1998).

Before the relationship between trust and control can be fully understood, trust and control must first be clearly defined, as must the forms of trust and the types of control that a firm may exercise in a relationship.

4.4.1.1 Trust

The common theme in almost all definitions of trust is the reference to expectations. To trust is to have "positive expectations about another's motives with respect to oneself in situations entailing risk" (Boon and Holmes, 1991: 194) and requires the firm to have the willingness to rely on the other firm in the exchange. Anderson and Narus (1990) focused on perceived outcomes of trust in their definition, but this seems more in line with confidence as a whole rather than just the single factor of trust. Moore (1998) chose a more cynical definition, which does, however, illustrate the inherent risks associated with trust: "willingness to expose oneself to the possibility of opportunistic behaviour in the belief that this opportunity will not be availed of". Therefore, trust is about expectations of other's motives and the acceptance of risk on the basis of a positive attitude towards the other firm's goodwill and reliability. Trust building takes time and effort on behalf of each firm (Dasgupta, 1988; Das and Teng, 1998; Lewis, 1999).

Sako (1992) distinguishes three different areas in which firms trust other firms: contractual, competence, and goodwill trust.

(i) Contractual trust – trusting firms will act honourably and obey the usual rules of exchange. Contractual trust, to some degree, is required in any economic exchange.

(ii) Competence trust – trusting the other firm's ability to perform and meet promises. Competence trust involves believing the other firm has satisfactory technical and organisational skills to meet specification. Credit worthiness is another aspect.

(iii) Goodwill trust – "mutual expectations of open commitment to each other" and a belief that the other firm is dependable and will refrain from opportunism. Goodwill trust is a characteristic of on-going inter-firm relationships and is the form of trust most referred to in this review.

Zucker (1986) identified three sources of trust: characteristic-based, process-based, and institutional-based. These sources have been adjusted and renamed by subsequent reviewers (e.g., Williamson, 1993; Gulati, 1995; McAllister, 1995; Moore, 1998), however the basic structure has prevailed.

(i) Characteristic-based trust – based upon ethnicity, family background, a firm being a domestic firm rather than an international company, trusting firms similar to self. The preferred term for characteristic-based trust is ascribed trust (Humphrey and Schmitz, 1996).

(ii) Process-based trust – based upon past and future exchanges between firms, and a firm's reputation.

(iii) Institutional-based trust – based on embedded social practices and relying on regulations, legal recourse, and guarantees.

Gulati (1995) defined two forms of trust: knowledge-based trust and deterrence-based trust, and noted the existence of characteristic-based trust. Knowledge-based trust is similar to Zucker's process-based trust in that it is derived from direct experience of relationships with the firm and from third-party sources. Deterrence-based trust encompasses Zucker's institutional-based trust, but includes other non-regulatory aspects. Deterrence-based trust relies on the belief that trustworthy behaviour will prevail as other firms consider the utility of behaving opportunistically if sanctions or penalties are to be imposed.

Williamson (1993) suggested that trust is no more than the assumption of risk on the basis of rational calculations. This opinion is not widely concurred with by the other reviewers. However, there is agreement that rational calculations are one aspect of trust.

Moore (1998) provides the clearest outline of factors contributing to Williamson's (1993) calculative trust, or the rational aspect of trust. Moore (1998) suggested that when a firm is deciding whether or not to trust another firm (trust is not a given, but rather is a dynamic belief that continually changes in degree along a continuum of trust), the firm implicitly makes two sets of assessments or calculations about the other firm: a character assessment and an incentive assessment.

(i) Character assessment – judgements about a firm's likely behaviour formed on the basis of past or typical behaviour of similar firms. The character assessment can be split into two categories: the generic character assessment and the specific character assessment, both of which can also be split into two categories.

- Generic assessment – firstly based on characteristics shared with the other firm that encourage trust (e.g., from the same village, country or club); secondly based on characteristics not shared with the other firm but are still believed to indicate trustworthiness (e.g., being of a particular profession, belonging to a religious group). Similar to Zucker's characteristic-based trust.

- Specific assessment – firstly based on previous direct interaction and experience with the other firm, and secondly based on the other firm's reputation with third-party companies. Similar to Gulati's knowledge-based trust and Zucker's process-based trust.

(ii) Incentive assessment – judgements about a firm's likely behaviour formed on the basis of the presence of incentives or deterrents in the case of honouring or breaking commitments. This assessment encompasses institutional-based trust. The five categories in the incentive assessment (although the boundaries are considered to be somewhat "fuzzy" (Moore, 1998)) are:

- Institutionalised sanction – the presence of a reliable third party that either automatically or on appeal is able to sanction the other firm (e.g., public law).
- Reputational jeopardy – the value the other firm places on their reputation and the damage that can be done to that reputation if society becomes aware of any opportunism.
- Direct retaliation – the fear that one firm instils in another firm that they can influence other aspect of their business.
- Non-cooperation – how important is it to the other firm that the first firm is willing to co-operate in the future?
- Interdependence – the poor performance or collapse of the first firm may have a negative effect on the second firm by not being available in the future.

The incentive assessment is perhaps similar to control, discussed below in Section 4.4.1.2. Gulati (1995) noted a debate as to whether utilitarian motivations can really be described as trust or not.

As noted earlier, the rational calculation is only one aspect of trust, and relates to the reduction of relationship risk. Trust also consists of a "leap" beyond the expectations that reason and experience alone would warrant. Such calculative reasons simply serve as a platform from which the "leap of faith" is made (Lewis and Weigert, 1985). Thus, trust comprises of two aspects: rational calculations and the subsequent "leap of faith" (Zaheer and Venkatraman, 1995).

Initial trust is not built because there has been no previous relationship. Rather, initial trust is based on a firm's disposition to trust (or more likely individuals' within the firm, as trust is essentially an interpersonal concept) (McKnight et al., 1998), the trust the firm ascribes to another firm based on characteristics of that firm, and incentives/deterrents for honourable/dishonourable behaviour. The "leap of faith" is also likely to contribute to initial trust more than long-term trust. As the relationship between the firms develops, the level of trust will increase and be reinforced.

Trust can be differentiated with respect to scope, i.e., generalised or selective. Generalised trust occurs in situations where trust is a characteristic of the exchange system as a whole, and trust is accorded to a wide range of firms. Selective trust is accorded only to particular firms (Humphrey and Schmitz, 1996). Selective trust can be either ascribed trust based on partner firm characteristics, or process-based trust, whereas generalised trust is largely based on institutional-based trust (Humphrey and Schmitz, 1996).

4.4.1.2 Control

Control, in relationship management, refers to the process by which one firm affects the behaviour of other firms it interacts with (Das and Teng, 1998). Control is about being able to make behaviour of other firms predictable through specification of detailed contracts, and, of course, favourable to oneself (Gulati, 1995; Das and Teng, 1998). The ability to make behaviour more predictable means the relationship risk is reduced, and confidence that the other firm will act satisfactorily is raised.

Control is separable into two categorises: formal control and social control (Das and Teng, 1998). Formal control is about evaluating performance, while social control is about dealing with people. Formal control mechanisms include outcome control and behaviour/process control, which measure, evaluate, and reward outcomes of behaviour (Das and Teng, 1998). The choice of formal control mechanisms is determined by transaction characteristics such as outcome measurability and transaction frequency (Ouchi, 1979) and also outcome observability and uncertainty (Eisenhardt, 1989a). Formal control serves to influence a firm's behaviour patterns by "delineating clear boundaries" (Das and Teng, 1998). Das and Teng (1998) suggested that control enhances trust because control mechanisms provide a track record or positive experience between firms. Such positive experience promotes trust (Zucker, 1986; Moore, 1998). However, Sitkin and Roth (1993) reported the limited effectiveness of legal solutions such as detailed contracts and formal rules for building trust.

Social control, in contrast to formal control, is about influencing other firm's behaviour through "soft" mechanisms. Firms and people can determine their own behaviour, thus, social control works to influence the behaviour of others by encouraging the sharing of goals, values and norms (Das and Teng, 1998). Social control occurs through socialisation, interaction and training, and, like trust building, mutual values, goals and norms are nurtured only slowly. Social control is slow to build, and considerable overlaps occur between establishing social control and building trust (Das and Teng, 1998). The positive relationship between trust and social control is noted by Barney and Hansen (1994), who suggested that trustworthy behaviour is encouraged when firms believe that to behave otherwise would be to violate values, standards, and principles of behaviour. Thus, there is perhaps a positive relationship between trust and social control, while formal control is likely to have a negative relationship with trust (Figure 4.4).

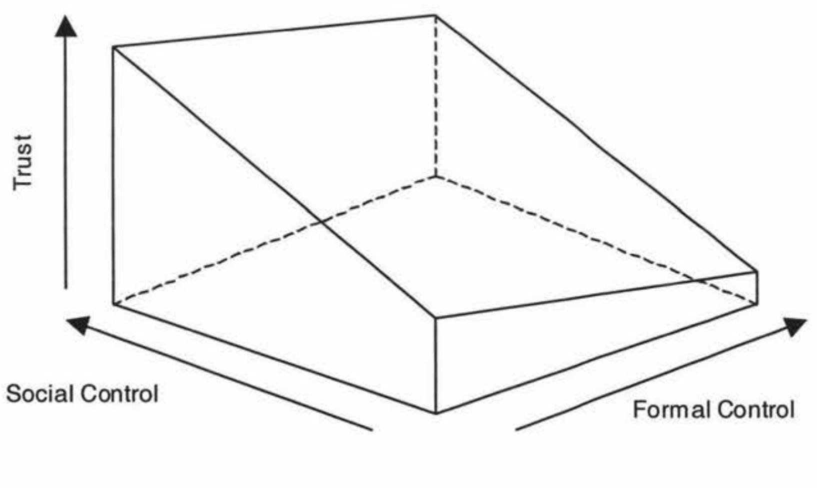

Figure 4.4: Trust, formal control and social control, and the possible complementary and supplementary relationships between them.

Trust is a moderator of control. The greater the level of trust a firm has for another company, the more effective a control mechanism will be, i.e., the more trusting a relationship becomes, the less stringent control mechanisms can be without forgoing any benefits or confidence (Das and Teng, 1998).

4.4.1.3 Confidence

Relationship confidence is derived from trust and control. As the vertical co-ordination strategy progresses away from a pure market approach towards more co-operative strategies, the requisite level of relationship confidence increases (Das and

Teng, 1998). Similarly, the contributions of trust, formal control, and social control to the relationship confidence change as the relationships become more co-operative in nature (Das and Teng, 1998, Ford et al., 1998; Moore, 1998).

Initially transactions and activities are less co-operative, and relationship confidence is largely based on formal control with some contractual trust. However, as firms enter increasingly co-operative ventures or as the period of relationship involvement becomes longer, trust (especially goodwill or process-based trust) dominates the basis of confidence in the relationship, and the contribution of social control also increases (Das and Teng, 1998; Rousseau et al., 1998). Competence or character-based trust becomes less important as relationship experience is built (Rousseau et al., 1998). Formal control becomes increasingly less important to building relationship confidence as co-operation expands (Das and Teng, 1998). Rousseau et al. (1998) suggested that institutional-based or contractual trust would remain constant, regardless of the length of time the relationship had evolved over (Figure 4.5).

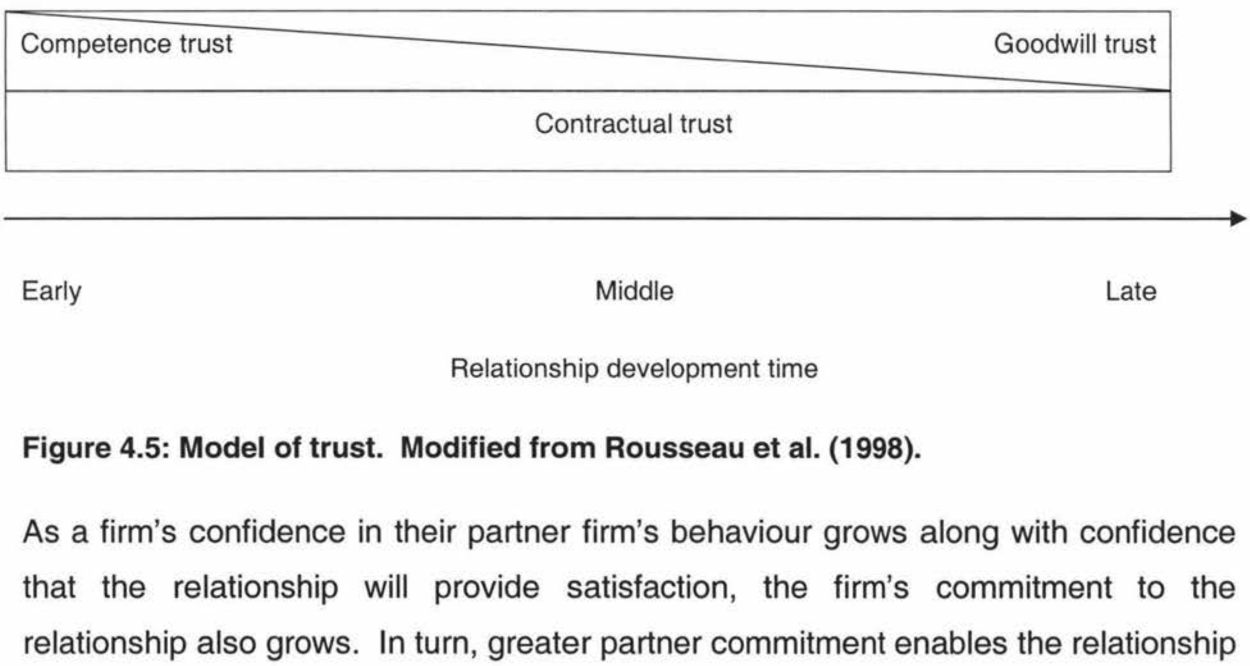

Figure 4.5: Model of trust. Modified from Rousseau et al. (1998).

As a firm's confidence in their partner firm's behaviour grows along with confidence that the relationship will provide satisfaction, the firm's commitment to the relationship also grows. In turn, greater partner commitment enables the relationship to become stronger, thereby increasing the satisfaction provided and the confidence each partner has in the relationship and the other partner (Zineldin and Jonsson, 2000).

4.4.2 Maintaining value chains

Mohr and Spekman (1994) in their study of characteristics of successful partnerships identified three behavioural characteristics associated with partnership success: attributes of the partnership, communication behaviour, and conflict resolution techniques. These factors were expanded by Monczka et at. (1998) to include the commodity/supplier selection process. Monczka et al. (1998) suggested that the degree to which these characteristics were present in an alliance act as predictors of success. These same factors are equally important in the successful management of supply chains and to the establishment of value chains because of the centrality of relationships in managed supply chains (Spekman et al., 2000) (Figure 4.6).

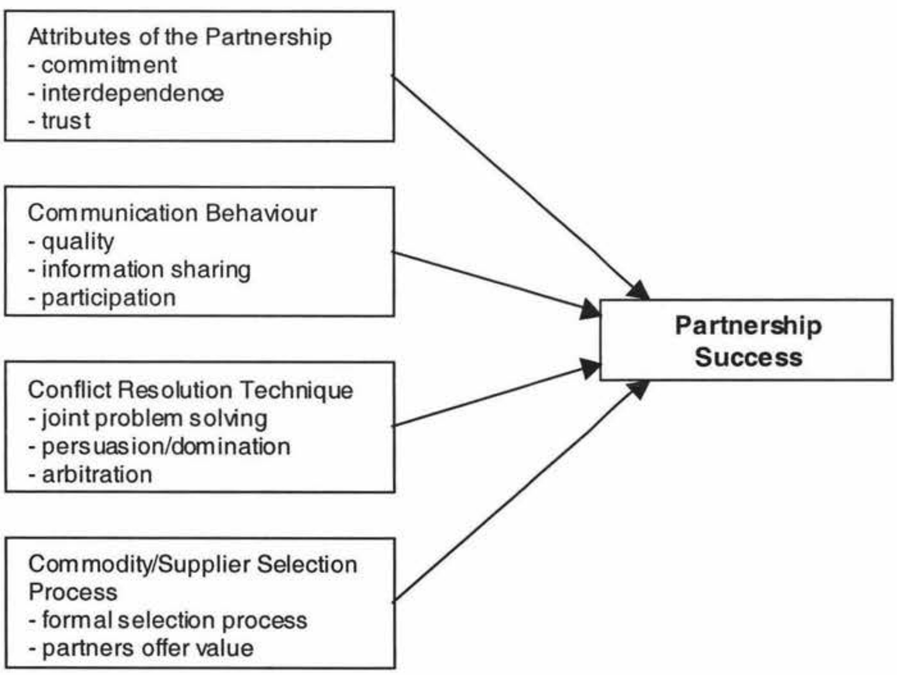

Figure 4.6: Factors associated with partnership success. Modified from Mohr and Spekman (1994) and Monczka et al. (1998).

4.4.2.1 Attributes of the alliance

The management of alliance relationships requires a different approach to traditional buyer-seller relationships. The key attributes of alliance relationships are trust, commitment, interdependence, a mutual need, and common objectives.

(i) To trust is to hold a positive attitude toward another firm's goodwill and reliability in a risky exchange situation. Trust between partners lowers transaction costs and reduces the need to monitor performance. Firms that are likely to make good partners are those that value their reputation as their most important possession (Lynch, 1989). These firms are more able to be trusted to do the right things (i.e., strategically and operationally), and to carry out the terms of the agreement. Firms need to behave towards each other in honourable ways that justify and enhance mutual trust (Kanter, 1994). Trust is considered to be the heart of today's economy, and is the foundation enabling firms to share their skills, knowledge, and resources to achieve results exceeding the sum of the parts (Dasgupta, 1988; Lewis, 1999; Spekman et al., 2000).

(ii) Commitment – refers to the willingness of partners to exert effort on behalf of the relationship. Firms usually show their commitment by investing time, money, facilities and staff, and often these resources are specific resources. Partnerships and supply chain relationships are more likely to be sustained when all partners are prepared to and do commit assets to future transactions and activities.

(iii) Interdependence – exists when one supply chain participant does not control all imperfectly imitable resources necessary for the delivery of products to the ultimate consumer. Firms with a high degree of control over another firm exhibit a high degree of opportunism while firms with very little control exhibit almost no opportunistic behaviour. A more balanced situation in which firms are dependent on each other (interdependency) leads to less opportunistic behaviour throughout the supply chain — a firm taking advantage of a partner will be acting to their own detriment because of their mutual need. Partners having a mutual need are those firms that have limited and preferably complementary resources, so co-operating allows the partners to more easily obtain their objectives than as individuals (Lynch, 1989; Kanter, 1994; Lewis, 1999). Mutual need provides the opportunity to co-operate.

(iv) Common objective – partners need a clear objective that they all agree upon and have faith that their partners will be committed to working towards (Lewis, 1999). All partners need to be satisfied that they are gaining from the relationship and that a win-win-win situation is being created. If one partner feels they are not gaining or not being treated fairly, they will undoubtedly terminate their involvement. Common objectives provide the guide for supply chain performance (Lewis 1999).

4.4.2.2 Communication behaviour

The flow of information and knowledge are critical aspects of any relationship (Spekman et al., 2000). Monczka et al. (1998) identified three aspects of communication.

(i) Information sharing – the extent to which critical and proprietary information (e.g., debt levels, cost structure, costs of production, growth plans) is provided to partners (Mohr and Spekman, 1994).

(ii) Information quality – refers to the accuracy, timeliness, adequacy and credibility of the information supplied. Information provided to a supplier inside the lead period is valueless.

(iii) Information participation – the degree to which partners plan and establish goals together (Mohr and Spekman, 1994).

4.4.2.3 Conflict resolution techniques

In any relationship conflicts will occur, and partners are unlikely to initially concur with every aspect of an agreement. However, if firms have taken the time and made the investment in a relationship they obviously believe there is strategic value to be obtained, thus to compromise that relationship could have an adverse affect on individual firm and supply chain performance. Therefore, overcoming differences between partners is of primary concern, requiring trust and commitment, and recognised means for dealing with crises and difficulties are essential (Zaheer and Venkatraman, 1995). Trust is central to conflict resolution (Zineldin and Jonsson, 2000). In some situations, agreement cannot be arrived at, so partners must agree to disagree, and dissolve the partnership. Dissolution will in some situations be the best possible mutual outcome. As Kanter (1994) noted: *"relationships between companies begin, grow, and develop – or fail – much like relationships between people"*.

There are three conflict resolution orientations:

(i) Constructive techniques focus on jointly eliminating the conflict. All partners need to jointly solve problems as and when they arise. It may be useful to employ a third party to assist in overcoming such problems, as described by Williamson (1979) in his discussion of neoclassical contracting. Most importantly, companies must take the time to learn any differences early and take them into account when planning. An understanding of the source of differences can save the relationship from being jeopardised (Kanter, 1994). Interpersonal relationships between partners can also assist in resolving conflicts (Kanter, 1994; Lewis, 1999).

(ii) Avoidance techniques involve ignoring or smoothing over differences without establishing the source of the problem and resolving the issue, leaving the opportunity for the conflict to flare up at a later date.

(iii) Destructive techniques involve a more powerful partner attempting to coerce another partner with threats, promises, or legal pleas. Such approaches can be harmful to relationships. In particular, trust can be destroyed.

Constructive techniques and internal resolution are the only appropriate means of overcoming conflict in co-operative relationships because of the need to maintain trust between partners and to maintain partner commitment to the relationship (Mohr and Spekman, 1994; Monczka et al., 1998). Third party arbitrators could be used, however Mohr and Spekman (1994) suggested that arbitration should only be used once or twice, and ongoing use of external agents to solve problems may indicate inherent problems in the relationship. One of the most effective means of resolving small conflicts before they escalate is to establish many interpersonal relationships between partners (Kanter, 1994). The establishment of interpersonal relationships allows firms to exert a degree of social control described in Section 4.3.3. Avoidance and destructive techniques work against the development of trust and do not encourage partner commitment (Mohr and Spekman, 1994; Monczka et al., 1998).

4.4.2.4 Commodity/supplier selection process

Monczka et al. (1998) found that firms that first formally selected the products for which they would enter a strategic supply partnership, and also for the particular supplier chosen, were more satisfied with the partnership than those firms without a formal selection process for products or partners. One company in their research only entered strategic partnerships with a supplier if that supplier had technology core to their operation, supplied high value products or was a single source supplier. A buyer contemplating a strategic supplier partnership needs to ensure that the supplier is capable of improvement, meeting requirements, and is prepared to establish a long-term relationship. There is little point in partnering a firm that has nothing of value to contribute to the partnership — individual excellence is important (Kanter, 1994). The process of partner selection is related to the establishment of confidence in prospective partner behaviour discussed in Section 4.4.1.

4.4.3 Relationship strength

The strength of an inter-firm relationship is a function of the individual firms' commitment to the relationship. This commitment is derived from each firm's confidence in their ability to obtain satisfaction and their confidence that the other partner will behave properly, and from the actual satisfaction obtained from the relationship. Trust, control, communication, and interdependence among various other factors discussed influence one or both of confidence and realised satisfaction. In turn, trust, interdependence, and communication are particularly enhanced by realised satisfaction. Thus, the situation is a circular one, and one that is highly complex and dynamic (Figure 4.7). If each firm behaves properly and is satisfied with the relationship outcome and their partner's behaviour, the firms are likely to co-operate further and to a greater degree, provided they expect to obtain some additional benefit/satisfaction from closer co-operation. Thus, there is the potential for an upward spiral, or ever increasingly closer relationships. However, one opportunistic action or one action lacking in sincerity by one partner, which adversely impacts the operation or reputation of the firm, could send the entire partnership into ruins.

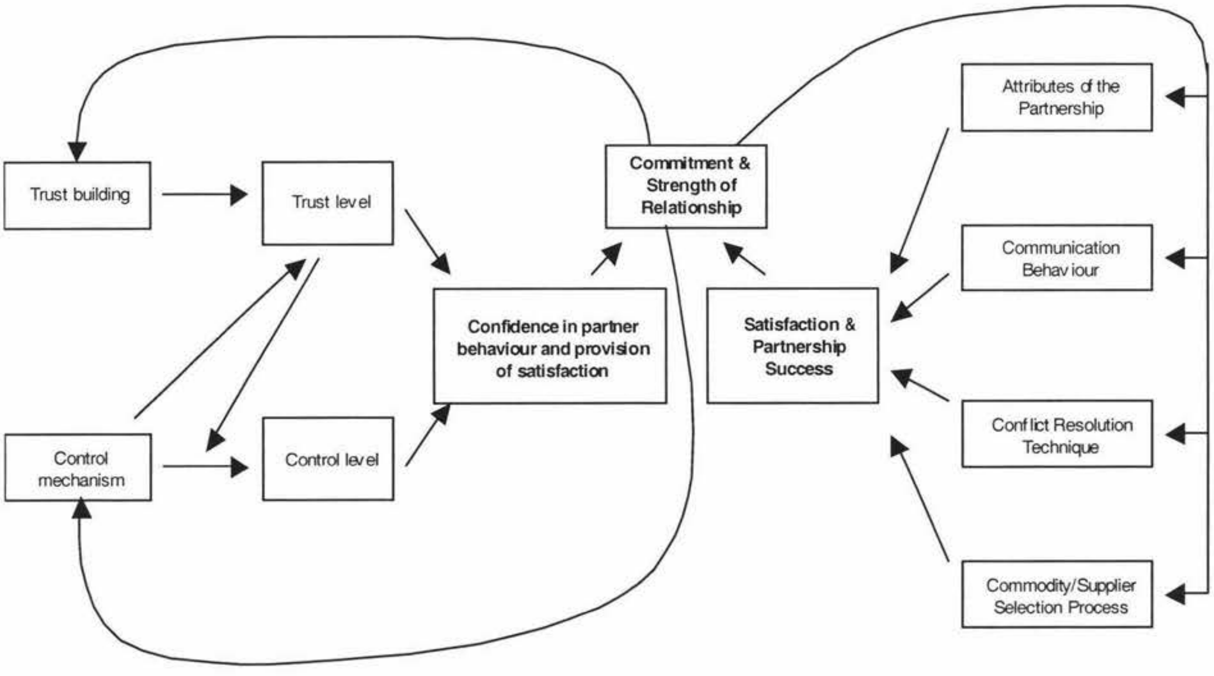

Figure 4.7: Partner satisfaction, confidence in partner behaviour and the drivers of relationship strength. Note: diagram modifies and combines Figure 4.4 and Figure 4.6 from above.

4.5 Chapter summary

- The strategic options for vertical co-ordination occur along a continuum, related to the degree of managed co-ordination characteristics displayed. This continuum ranges through three broad co-ordination strategies: market, co-operation, and vertical integration.

- Market transactions are isolated acts of trade where neither participant accepts any obligation with respect to future conduct, and no continuing association is expected.

- Co-operative arrangements occur between two or more firms and involve: obligation and assurance, a commitment of resources, and a common objective. The co-operative strategy can be split into three sub-strategies along the vertical co-ordination continuum: contracting, strategic alliances, and formal co-operation.

- Vertical integration is the creation of a single entity with control over all aspects of the transaction — activities are internalised.

- The firms operating to transform raw material into goods for purchase by consumers form a supply chain. A value chain is a supply chain that is co-operatively managed with vertical linkages between firms, and is focused on competing as a chain to create value for customers.

- Commodities are largely traded on a spot market. The purpose of co-ordination in such a market is to allocate the share of a fixed value. Market participants are isolated and receive no feedback. The spot market continues to exist because many farmers prefer to retain their independence, and the invisible quality risk.

- The motives for the creation of value chains are: to leverage assets, capabilities, and inputs; to reduce uncertainty with respect to quality, volume, timeliness, prices and access; and to better match consumer demands as a supply chain.

- Drivers of change in supply chain co-ordination are: new technologies, regulations, and ultimately, consumer preferences.

- A firm's value chain partners are chosen because they are confident the chosen firm will act truthfully and with commitment, and that the partnership will provide satisfaction to both firms. Trust and control are central to confidence.

- Value chain partnerships are successful when both partners behave satisfactorily towards each other. This involves: trust, interdependence, commitment, communication of quality information, joint planning and problem solving, and having something of value to offer the other firm.

5 Development

Development represents a transformation of society (Stiglitz, 1998, Alsop et al., 2000). Stiglitz (1998) suggested development is a movement from traditional to more "modern" ways of thinking, dealing with health and education, and producing food and other goods. He also noted that change is not an end in itself, but rather the means to other objectives. Changes should provide individuals and societies with greater control over their destiny. Individuals' lives should be enriched with wider horizons and a reduced feeling of isolation (Stiglitz, 1998).

The purpose of development strategies is to facilitate the transformation of societies, with a focus on two aspects: identifying and eliminating barriers to change, and identifying and promoting catalysts of change (Stiglitz, 1998). Change is necessary where people are not satisfied with their lives.

5.1 Approaches to development

During the 1980s and 1990s, development strategies, particularly those of the World Bank and the International Monetary Fund, were based on the "Washington Consensus" theory of economic liberalisation (UNDP, 1999a). These strategies demanded that developing countries implement market liberalisation policies, i.e.,:

(i) Removal of trade barriers enabling foreign firms to more readily compete in the domestic market;

(ii) Reduction or elimination of subsidies and price controls because these mechanisms "distorted" domestic prices;

(iii) Financial system restructuring;

(iv) Privatisation of state owned enterprises;

(v) Removal of control over private foreign investment; and

(vi) A reduction in state involvement in the economy and also the provision of social services (UNDP, 1999a).

This top-down strategy has failed to improve the livelihoods of the poorest communities in developing nations (Stiglitz, 1998; UNDP, 1999a). Such policies have excluded rural communities and have worked to benefit the relatively wealthy urban sector, especially bureaucrats and owners of large businesses (UNDP, 1999a).

The strategy for investment in development now being proposed by the UNDP is termed "Investment in Sustainable Livelihoods", which is an asset-based approach to development. The key differentiating aspect of this approach over previous methods is the recognition that people are resourceful and do have their own forms of assets and strategies. Income generation and employment schemes promoted by development agencies in the past assumed that people needed something more productive to do in order for them to rise above poverty. However, it is now recognised that people are already productive, and over many generations have developed means of coping and adapting to changes in their environment. The problem involves structural changes, such as unequal terms of trade and unequal power relationships, that have eroded peoples' assets, resourcefulness and resilience (UNDP, 1999a).

The goal of an asset-based investment strategy is to build upon existing assets and resources in order to expand people's choices, capabilities. and their potential to make choices (UNDP, 1999a). The UNDP (1999a) considers there to be four types of assets, each of which must be appreciated in the design of any development strategy: social, human, physical, and natural assets. In the discussion of resources in Chapter 2, social assets were viewed as being part of the operating environment, as were physical assets such as infrastructure. Natural and human assets have the same definition as in the earlier discussion. Definitions aside, the important consideration is that development strategies must not focus on a single or small number of aspects of livelihoods. All aspects must be understood along with the relationships between aspects and the impact and significance of each must be appreciated. Development strategies must look at the entire system within which the people are operating. For example, when considering a credit scheme, it is important to understand whether the concept of credit fits within the community's social values, how families currently deal with stresses and shocks, what are the existing sources of credit, what are the seasonal variations in cashflow, the value and uses of livestock, and current levels and types of savings.

Before continuing further in the discussion of development strategies and what development programmes achieve, it is important to have an understanding of what a livelihood is and what constitutes poverty.

5.2 Livelihoods and poverty

A livelihood is the means of gaining a living (Chambers and Conway, 1992). The focus of development is now on assisting people to have sustainable livelihoods (UNDP, 1999a).

5.2.1 Livelihoods

Chambers and Conway (1992), in their discussion of sustainable livelihoods, proposed three linked concepts fundamental to a framework for looking at livelihoods: capability, equity, and sustainability. They also noted that these concepts were their own and not those of the people whom they were attempting to assist. Each concept is both an end and a means.

Capability refers to the ability to perform certain functions, and to what a person is capable of doing and being (Sen, 1984, 1987). It includes the ability to nourish and clothe oneself, and the ability to cope with stress and shocks (Chambers and Conway, 1992). The ability to deal with stress, and seek and utilise opportunities are not just reactive, but are also proactive and dynamically adaptable. Such proactive capabilities include gaining access to and using services and information, innovating and experimenting, competing and co-operating, exercising foresight, and exploiting new situations (Chambers and Conway, 1992). A livelihood provides the opportunity for an individual to enhance and exercise their capabilities (an end), and capabilities enable a livelihood to be gained (a means).

Equity has traditionally referred to income distribution, but can be used far more widely to refer to the distribution of assets, capabilities and opportunities. Equity requires that everybody has adequate and decent livelihoods (an end), and equity in assets, capabilities, and opportunities is required for individuals to gain a decent livelihood (a means) (Chambers and Conway, 1992).

The term sustainability has been used widely to refer to various concepts (e.g., environmental sustainability and social sustainability). Here, sustainability refers to both environmental and social sustainability — stewardship of resources so that their value is either maintained or enhanced, and whether an individual or the family/household unit can gain a decent and adequate livelihood over time, recover from shocks, and maintain and enhance capabilities for future generations (Chambers and Conway, 1992).

Chambers and Conway (1992) suggested four components of a household livelihood:

(i) People – their livelihood capabilities

(ii) Activities – what they do

(iii) Assets – tangible (resources and reserves) and intangible (access and claims) providing material and social means

(iv) Output – a living, the gain from what the people do

Of these, the most constraining are capabilities (discussed above) and assets. Assets in this sense are the resources people have at their disposable (as discussed in Chapter 2), and include human, physical, and capital resources. At this point it is useful to consider an alternative categorisation of these assets into tangible and intangible assets.

(i) Tangible assets: resources – land, water, trees, livestock, machinery, and tools; and reserves – food stocks, cash savings, jewellery, and stocks of handcrafts made by the household members.

(ii) Intangible assets: access – the opportunity to use resources, services, obtain and use information, extension, technology, education, and health; and claims – demands and appeals made for material or other access and support, based on combinations of right, precedent, social convention, moral obligation, and power (Chambers and Conway, 1992).

The living or output is the core of a livelihood, with capabilities and assets contributing to the livelihood via activities (Figure 5.1).

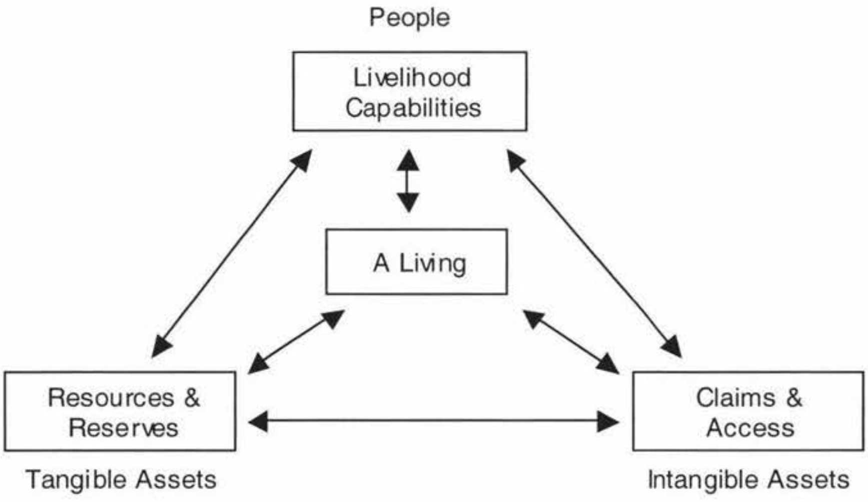

Figure 5.1: Components and flows in a livelihood. Source: Chambers and Conway (1992).

5.2.2 Poverty

The now traditional view of poverty is that it encompasses material deprivation as well as low levels of education and health (World Bank, 2000). The World Development Report 2000 expanded this definition to include vulnerability, the exposure to risk, voicelessness, and powerlessness (World Bank, 2000). These deprivations all severely compromise what Amartya Sen calls "the capabilities that a person has, that is, the substantive freedoms he or she enjoys to lead the kind of life he or she values" (Sen, 1999).

5.2.3 The causes of poverty

Poverty tends to be associated with distance from cities and the coast. The World Development Report 2000 highlighted what were claimed to be the dimensions of poverty raised by poor people:

(i) Lack of income and assets to attain basic necessities – food, shelter, clothing, and acceptable levels of health and education.

(ii) Sense of voicelessness and powerlessness in the institutions of state and society.

(iii) Vulnerability to adverse shocks and the inability to cope with them.

One way of viewing poverty is to look at the assets people have, the return on those assets or their productivity, and the volatility of the returns (World Bank, 2000). The return on assets depends upon access to markets and all the global, national, and local influences on these markets, as well as the performance of the state and society (World Bank, 2000). The operating environment — general, competitive, and internal environments — determines the return on assets, as outlined in Chapter 2.

5.2.4 Lack of income and assets, and vulnerability

Poor people consistently emphasise the central role work has on improving their lives (World Bank, 2000). A country's overall wealth has an important influence on this — as countries grow richer, the average poor person also gets richer, with the main mechanism being better paid work. However, the rate at which poverty is reduced depends upon the distribution of the new wealth. Wealth distribution is always unequal, so policies designed to confront socio-economic inequalities are an important means of ensuring that poor people also gain from a nation's growth (World Bank, 2000).

For poor people, vulnerability or exposure to risk is closely related to their lack of assets, and hence they have a high level of vulnerability. The cause of their vulnerability is their inability to reduce or mitigate risk. Having a low level of assets reduces a person's ability to cope with negative events compared with another person with more assets, provided the shocks are of a short-term nature. For example, having no cash or feed reserves during a drought essentially means a family relying on rain-fed crops for food has almost no means of coping with the immediate situation. Sometimes, poor people take actions such as selling capital livestock, taking children out of school to work, or over-cultivation, in an attempt to cope with a shock or mitigate risk in the short-term. But by doing this they actually worsen the long-term situation, creating a downward spiral (World Bank, 2000).

Another, and perhaps more serious, underlying cause of vulnerability is the inability of the state or the community to develop risk mitigating mechanisms (e.g., irrigation schemes, infrastructure, credit, fair legal systems) (World Bank, 2000). Poor people are also exposed to risks in the general environment.

5.3 The required focus of development programmes

The key ingredients of a successful development programme are ownership and participation (Stiglitz, 1998). Development programmes must include components directed at the public sector (the traditional target, because the development plans were plans for government), the private sector, the community, the family or household, and the individual. Each of these components is intricately linked to the other components (Stiglitz, 1998). For example, education is the focus of the development of individuals; but these enhanced skills are of considerable value to the private sector, and the higher wages earned by women as a result of their education has a significant impact on a family's situation. Without components directed at each of these sectors, not everybody who should be involved will be, and not everybody will own the process, and without ownership, commitment to the programme will be lacking.

As has been discussed in Chapters 2 and 3, and also in this chapter, poor farmers often do not adopt new technologies because either they do not have access to the critical resources, services, markets, or information; or the risk that adoption would entail is considered too great as to significantly raise their vulnerability (Nweke and Akorhe, 1983; Arnon, 1989; Baidu-Forson et al., 1997).

Thus, development programmes need to focus firstly on providing the infrastructure and the mechanisms necessary to offer poor people the opportunities to enhance their livelihoods (i.e., the organisational and social capacity — the institutions enabling a society to function well). Secondly, the focus must also be on providing people with the education necessary to take advantage of the opportunities available (i.e., build the human capacity — skills and knowledge required for development) (Stiglitz, 1998). Development programmes must also be sustainable, both socially and environmentally (Chambers and Conway, 1992; UNDP, 1999a).

5.3.1 Infrastructure and enabling mechanisms

Well-functioning markets create opportunities for poor people to escape poverty (World Bank, 2000). Access to services, credit and information is central to development. Market reforms in developing nations have had varied results in reducing poverty levels, but generally results have benefited the poor (World Bank, 2000). The World Bank cited cross-country evidence suggesting the reforms had

had little effect on income distribution, and that the benefits from reforms are usually evenly spread around the economy. Meanwhile, the costs of such reforms are often quite unevenly distributed. For example, trade liberalisation can lead to a rapid decline in employment in previously heavily protected sectors in which the country has no comparative advantage, and it may take these redundant workers some time to re-skill and gain employment in new growth sectors. Such effects have occurred in China, not as a result of trade liberalisation, but due to the closure of loss-making state owned enterprises (Economist, 1997; World Bank, 1997b, 1999). This highlights the need to include adequate social policies with drastic market reform.

Basic infrastructure has a key role to play in helping to establish income-earning activities and employment for poor people. The UNDP (1999a) suggests that investment should be channelled into:

(i) Developing rural market infrastructure

(ii) Aspects of infrastructure that overcome existing constraints to economic activities, e.g., transport, water, and electricity

(iii) Raising the efficiency of existing infrastructure, e.g., energy efficiency

(iv) Improving the access of poor people to reliable information, allowing them to find out about employment, training opportunities, and the current market conditions.

However, before such investments are made, it is essential that a competition and regulatory framework be established (Stiglitz, 1998). This is to ensure that markets can function properly and fairly, and may include promoting core labour standards and reduced regulatory burdens for small enterprises (World Bank, 2000). One of the inhibitors to policy makers undertaking such regulatory reforms is that the overall return will be low — the markets poor people predominantly participate in are generally small, thus there is little incentive to promote change (World Bank, 2000). Financial reforms are critical to offering opportunities to poor people, especially through micro-finance.

Micro-finance enables poor people to participate in activities from which they would otherwise be excluded, and is central to building their capacity and developing sustainable livelihoods. However, credit has been shown to be relatively ineffective in supporting the poorest of the poor or the most vulnerable populations. The poorest people tend to use loans for risk-reducing purposes such as consumption and low-risk production technologies, while less poor people (i.e., above the poverty line) tend to use loans for more risky and productive investments, including technology (UNDP, 1999a). For the poorest of the poor, other poverty reduction mechanisms must first be employed, such as the provision of social services and basic infrastructure. The UNDP noted that there are also differences in the value obtained from micro-finance by males and females. Men tend to specialise and aim for growth, while women tend to spread risk and ensure economic security for the household (UNDP, 1999a).

Health is also an important aspect of development. An unhealthy population cannot be a productive workforce (Stigltiz, 1998). The ill health of an adult in a poor family can have quite disastrous consequences on the entire family; direct effects include the losses of cash income, production, and provision of food, and indirect effects include the added pressure and work borne by the other family members, or having a child withdraw from school to help produce food or earn money to pay for the health care. Health education is an important component of preventative health care.

5.3.2 Skills and knowledge

Stiglitz (1998) claimed that education is the core of development — if development represents the transformation of society, education is what enables people to learn, accept, and help engender this transformation. Without education, a country cannot attract and build modern industries or adopt new technologies as rapidly in the rural sector. Increased knowledge of production practices can lead to considerable gains in output from the same amount of resources (Stiglitz, 1998).

5.3.3 Sustainability

As discussed above, sustainability refers to both environmental and social sustainability. Environmental sustainability concerns the external impact livelihoods have on other livelihoods — the effect of livelihoods on local and global resources and assets. Social sustainability concerns an individual's internal capacity to withstand external pressures — the ability to cope with stress and shocks, and to retain the ability to continue and improve (Chambers and Conway, 1992).

Environmental resource sustainability can be broken into two levels: local and global (Chambers and Conway, 1992):

(i) Local tangible asset sustainability is about whether the livelihood activities maintain and enhance, or degrade and destroy, the local natural resource base (e.g., negative – deforestation, soil erosion; positive – tree planting, manure).

(ii) Global tangible asset sustainability is about whether the livelihood activities make a positive or negative contribution to the long-term environmental sustainability of other livelihoods (e.g., pollution, global warming). Communities well removed from the source often feel the impacts of livelihood activities.

Any development programme must appreciate that any natural environment has limits as to how much economic activity, and the types of economic activity, that can be supported. A mix of enterprises should be promoted; especially those that are complementary and can use by-products or waste from the other enterprises (UNDP, 1999a). Enterprises must be matched to the resource base.

Environmental sustainability is also about the preservation and enhancement of intangible assets such as access. Again, intangible environmental sustainability can be grouped in two levels: local and global (Chambers and Conway, 1992):

(i) Local intangible asset sustainability is about individuals retaining the right of access to services and resources. In developing nations, resource and service access could be appropriated by large firms or local bureaucrats, or could be diminished or eliminated by law, force or bureaucratic barriers. The death of a key family member may also affect a household's access or claims, especially if those claims and access are guaranteed only to that person.

(ii) Global intangible asset sustainability is about the threats posed by international trade, trade sanctions and barriers, tariffs and trade agreements. The impact of these activities can quite readily flow down to local levels.

Social sustainability has two dimensions: proactive and reactive. The reactive dimension involves coping with stress and shocks, while the proactive dimension involves enhancing and exercising capabilities while adapting to, exploiting, and creating changes and opportunities, and in assuring continuity (Chambers and Conway, 1992).

(i) The reactive dimension – the ability to cope with stresses (i.e., pressures which are continuous and cumulative, like soil degradation and the effect on crop yield), and shocks (i.e., sudden and unpredictable events, like floods, fires, market collapse) (Conway, 1987). Droughts are intermediatary in nature, but have an effect more like that of a shock because they are largely unpredictable and occur irregularly. Most shocks can be classified as occurring within Emery and Trist's (1965) placid and random environment, while market collapse could sometimes be classified as occurring within a turbulent field, but this would depend upon the cause of the collapse. A collapse due to local oversupply is a turbulent field outcome, while a collapse due to international trade activities is probably not. Stresses affect the whole community (e.g., population pressure, deforestation), while shocks can affect individuals (e.g., illness, theft of assets, loss of employment) or the entire community (e.g., floods, endemics, market collapse) (Chambers and Conway, 1992). The coping or risk reducing strategies employed by people have been discussed in Chapter 2.

(ii) The proactive dimension – social sustainability depends upon individuals being able to perceive, predict, adapt to and exploit changes in the environment (Chambers and Conway, 1992; Kaine et al., 1994). Learning is central to this ability. Learning results from experimentation, monitoring, and communication and interaction with other individuals (Kamp, 1996, cited in Scarborough et al., 1997). Proactive capabilities are essential to social sustainability, especially intergenerational sustainability (maintaining and enhancing capabilities for future generations). The direct form of intergenerational sustainability occurs through parents teaching their children the skills and knowledge necessary to operate their enterprises. The indirect form is achieved through children moving on to other places and being employed in other occupations where they are able to create new livelihoods. To this end, families often invest in education. Similarly, the importance of ensuring access to education for poor people is highlighted, because as the stresses increase in the rural environment, the need to create new livelihoods becomes more critical (Chambers and Conway, 1992).

5.4 Public-private partnerships

Public-private partnerships are joint initiatives of the public sector in conjunction with the private sector — profit and non-profit — commonly referred to as government, business and civic sectors. Within these partnerships, each participant contributes resources (e.g., finance, human and technical resources, and intangible resources such as information and political support), and each sector participates in the decision making process (Fizsbein and Lowden, 1999, Alsop et al., 2000).

5.4.1 Public-private partnerships in development

Public-private partnerships have become common for several reasons. Decentralisation of economies and political systems has encouraged local governments to look for support from business, because funding at lower levels is scarcer than at higher levels. In turn, this has encouraged local governments to support business with suitable operating conditions enabling rapid growth and greater contributions to local government activities (Fizsbein and Lowden, 1999). Also partnerships have become more common in development work because the development community has recognised the importance of social capital in equitable and sustainable growth (Fizsbein and Lowden, 1999).

Fizsbein and Lowden (1999) suggested that public-private partnerships offer significant potential as an approach to poverty reduction. This is primarily because they offer a means of creating organisational and normative assets that can be used to provide material benefits to peoples' livelihoods while also creating capability assets as a by-product. Such partnerships have the potential to generate self-reinforcing patterns of change in communities.

Partnerships, as in Chapter 4, refer to a mutually interdependent relationship between the various actors, unlike the more traditional contractual or principal-agent relationships between development actors (Alsop et al., 2000). Similarly to reviewers of supply chain relationships, Fizsbein and Lowden (1999), identified trust as being central to social capital, the creation of which is now considered critical to the development process and sustainable development. "Social capital refers to the features of social organisation, such as networks, norms and social trust, that facilitate co-ordination and co-operation for mutual benefit" (Putnam, 1993, p. 35). Alsop et al. (2000), also concurring with supply chain management reviewers, identified information sharing, common knowledge creation, and joint decision making as being key to successful partnerships.

Fizsbein and Lowden (1999) suggested that partners are strengthened in two ways: the output of the partnership, and the learning achieved from working with other sectors. It is possible to establish win-win-win partnerships like those discussed in Chapter 4. Examples of the types of gains made by the different sectors are (Fizsbein and Lowden, 1999):

(i) Business – improved reputation of companies creating brand loyalty and increases in market share and coverage; improved employment relations and increased employee satisfaction resulting in quality and productivity gains; higher education level of employees and improved relationships with local and central public authorities often making business operations smoother.

(ii) Civic society – the core activity of civic society is achieving the goals of the partnership, and participation in such partnerships increases effectiveness and efficiency in securing inputs and support, and the ease with which partnership goals are fulfilled. Opportunities can also exist for expansion into new activities.

(iii) Public – partnerships offer the public sector the opportunity to establish credibility in being an honest partner and participant. This is particularly important in nations where corruption has eroded credibility. Partnerships also allow the state to transform their role from that of implementer to facilitator, perhaps with a considerable benefit to other participants.

(iv) The poor – capacity-building is perhaps the largest benefit for poor people, together with enabling them to identify and create reasons and stimulus to grow and develop. The creation of social capital is a positive form of social development, and high levels of social capital create the conditions for making tangible gains leading to "virtuous circles of co-operation and development" (Fizsbein and Lowden, 1999, p. 39).

Much of the infrastructure required in developing nations can be provided by the private sector as long as the government first establishes the appropriate regulatory and legal environment (Gerybadze, 1995; Stiglitz, 1998). In public-private partnerships, the resources of the private sector can be tapped where services are affordable but where access is a problem. However, where affordability is the major problem, or where the private sector is reluctant to invest because of the presence of the free-rider phenomenon, the responsibility to provide public goods and services falls back on the government (Gerybadze, 1995; UNDP, 1999a).

5.4.2 Creating an enabling environment

Before public-private partnerships can establish, governments need to ensure that regulations are in place enabling the creation of such partnerships and eliminating bureaucratic roadblocks (Alsop et al., 2000). Decentralisation is critical to enabling partnerships. Decentralisation should strengthen the "state" at the local level, where it can most effectively work with non-state actors (Fizsbein and Lowden, 1999; Alsop et al., 2000). Having funding available, authority and responsibility at the local level ensures that action can be taken – an on-site presence is critical to success in development projects (Fizsbein and Lowden, 1999). Governments must also be prepared to devolve authority to non-state actors, particularly the private sector, enabling these sectors to produce goods or provide services to poor people (Karen, 1985; Pray and Echeverra, 1990; Fizsbein and Lowden, 1999).

Traditional business thinking also constrains the establishment of public-private partnerships. Companies need to perceive that they have a role in poverty alleviation, and also that involvement in poverty alleviation does offer benefits to participating companies (Karen, 1985; Gerybadze, 1995; Fizsbein and Lowden, 1999; Roddick, 2000). Companies such as Thailand's Charoen Pokphand (Karen, 1985) and the UK's The Body Shop (Roddick, 2000) have recognised that a "cohesive society is an essential foundation for business success and that companies thrive with healthier, better-educated and more productive people" (Roddick, 2000, p 26).

Donors need to appreciate that allocating aid resources to bringing the private and public sectors together will have more immediate and direct results than allocating aid solely to government organisations where demonstrable development outcomes are uncertain (Karen, 1985).

5.5 Chapter summary

- Development is a transformation of society. Change is not the end, but rather the means to other objectives.
- The "Washington Consensus" approach to development has failed to improve the livelihoods of poor communities in developing nations.
- The current recommended development strategy aims to build upon existing assets to expand peoples' choices, capabilities, and their potential to make choices. The focus is to assist people to have sustainable livelihoods.
- A livelihood is a means of gaining a living. A livelihood is based upon: capability, equity, and sustainability.
- Capability refers to the ability to perform certain functions, and to what a person can be. Capabilities are proactive (e.g., gain access to information), and reactive (e.g., the ability to cope with the shock of a flood).
- Equity refers to the distribution of assets, capabilities, and opportunities. Assets are both tangible (e.g., resources and reserves), and intangible (e.g., access and power).
- Sustainability refers to environmental and social sustainability. Environmental sustainability concerns the impact livelihoods have on other livelihoods, and the preservation of resources. Social sustainability concerns coping with shocks and stresses, enhancing capabilities, exploiting opportunities, and assuring continuity.

- Learning is central to improving livelihoods. Increased knowledge of production practices can increase the output from the same inputs and resources. Enterprises should be matched to the resource base.

- Businesses should become more socially responsible. Healthier, better-educated, and more productive people are good for economic activity and business output. Such people also generally have more sustainable livelihoods.

6 Setting the Scene: Case Study Description

6.1 Poverty in China

In China, most of the poor people are located in mountainous regions or in remote townships (World Bank, 2000), however poverty is increasing in the urban areas as unemployment rises (ADB, 2000). A definite inequality between rural and urban residents exists, and such differences also occur between provinces (e.g., rural hospital use has declined by 10% during the period 1985–1993, while urban health care use increased by 13% for the same period (World Bank, 2000)). However, the level of poverty in China has dropped significantly[16]. In 2000, the number of people suffering from poverty in China could be as few as 27 million[17] (the State Bureau of Statistics estimate based on 635 RMB/capita annual income in rural areas), or considerably higher at 230 million (international estimates based on $1US/day with 1985 purchasing parity) (ADB, 2000). If the poverty line is raised to $2US/day, the number of poor people almost triples to 670 million (ADB, 2000).

In China, a lack of physical assets is a determinant of both chronic and transitory or temporary poverty. However, household size and household head education determine the likelihood of chronic poverty, but not transitory poverty (World Bank, 2000).

Despite the huge variations in poverty estimates, there is little disagreement that the national economy is expanding rapidly and that some rural people have benefited from this growth. The early 1990s saw meteoric rises in rural incomes[18], when

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[16] There are conflicting reports on the degree of reduction in poverty. Official government statistics state that in 1978 there were 260 million rural poor (33% of the rural population), that by 1990 the number of rural poor had fallen to 85 million (10%), and that in 1997 the number of rural poor was 50 million (5.4%). International sources suggest the level of poverty in rural areas in 1990 was 31% (280 million), and by 1997 it is believed that the number of rural poor had fallen to 124 million (13.5%). There are no international estimates of the number of poor people earlier than 1990. Sources: World Bank (1999) and Wang Sangui (1998) quoted in: Rozelle et al. (1999); UNDP (1999b).

[17] Million = 1,000,000.

[18] Annual rural net per capita income doubled from 784 RMB in 1991 to 1578 RMB in 1995 (UNDP, 1999b).

inflation was high[19], but in the late 1990s, rural incomes stopped rising and began to fall in real terms (China Daily, 1998), when inflation was very low and deflation began. The central government has realised that rural sector income growth is critical if the national economy is to continue growing at the targeted 8% (China Daily, 1998).

6.2 Food consumption in China

In the mid-1960s, people in China ate predominantly rice, wheat, and starchy roots (Rae, 1995; Heilig, 1999). These cereals contributed about 67% of daily energy intake while roots provided about 14% (FAOSTAT, 1999, cited in Heilig, 1999). Consumption of vegetables, fruit, and meat was very low (Rae, 1995; Heilig, 1999). The FAO estimates daily per capita meat consumption to have been only 77 kcal in China in 1964–1966 (equivalent to 3.9% of daily intake). Vegetables and fruit contributed 1.9% and 0.5% of daily energy intake, respectively.

The most recent FAO survey (1996) (Table 6.1) shows significant changes have occurred. Daily meat intake has quadrupled to 335 kcal/day (11.3% of average daily intake), and total animal products now contribute 16.7% of daily energy intake. Similarly, the consumption of vegetables has tripled, and fruit consumption has quadrupled. Rice intake has increased, but as a proportion of total consumption it has declined. From 1961 to 1996, total average daily consumption has increased by 73% from 1642 kcal/day to 2844 kcal/day (FAOSTAT, 1999).

A country's food consumption patterns change over time, and such changes are usually closely related to increasing income levels. Food consumption patterns in East Asia are undergoing similar changes (Rae, 1995). Garnaut and Ma (1992, cited in Rae, 1995) identified three distinct phases of food consumption. Initially, food consumption growth is in the traditional foods such as rice and starchy roots. The second phase involves an increase in non-traditional foods such as wheat and reduced reliance on rice and root crops. The final phase sees the continued decline in rice and root crops and rapid increases in the consumption of animal products,

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[19] Inflation in China peaked in 1994 at 24.2%. In 1997, inflation was only 0.8% and in 1998 had fallen to –2.6% (OECD, 1999).

vegetables, fruit, and wheat (Rae, 1995) (Figure 6.1). Rae (1995) also noted that a fourth phase is beginning to emerge in Western economies as consumers become more concerned with health issues and shift away from some animal products back towards cereal-based foods.

Table 6.1: Energy (kcal) available from selected foodstuffs for human consumption per capita in China, 1961–1996. Source: FAOSTAT. Electronic Database (data downloaded from internet: February 16, 1999)

Foodstuff	1961	1978	1996
Wheat	159	393	616
Rice	496	849	931
Maize	172	193	88
Other Cereals	186	121	36
Starchy Roots	296	290	161
Vegetables	66	35	106
Vegetable Oils	27	54	123
Fruit	11	10	47
Fish & Seafood	8	9	30
Meat	28	95	335
Milk	6	6	16
Other Animal Products	13	27	104
Alcohol	8	20	86
Total	1642	2235	2844

Added to consumers' concerns about the healthiness of animal products, is the increasing concern with production methods, animal welfare, and environmental pollution, requiring supply chains to be able to trace products and verify practices used (den Ouden et al., 1996). These changes are also occurring in Asia (Rae, 1995), especially in the relatively wealthy eastern coastal cities in China (e.g., Shanghai, Beijing, Guangzhou). These consumers are demanding high quality meat products (Zhang et al., 1997; ClearThinking.com, 2000), as well as other animal products such as leather (Zhang et al., 1997) and milk. Domestic supply is currently insufficient to meet this demand for high quality beef, and high levels (relative to amounts of locally produced high quality beef) of imports are necessary to meet this demand (Zhang et al., 1997; ClearThinking.com, 2000).

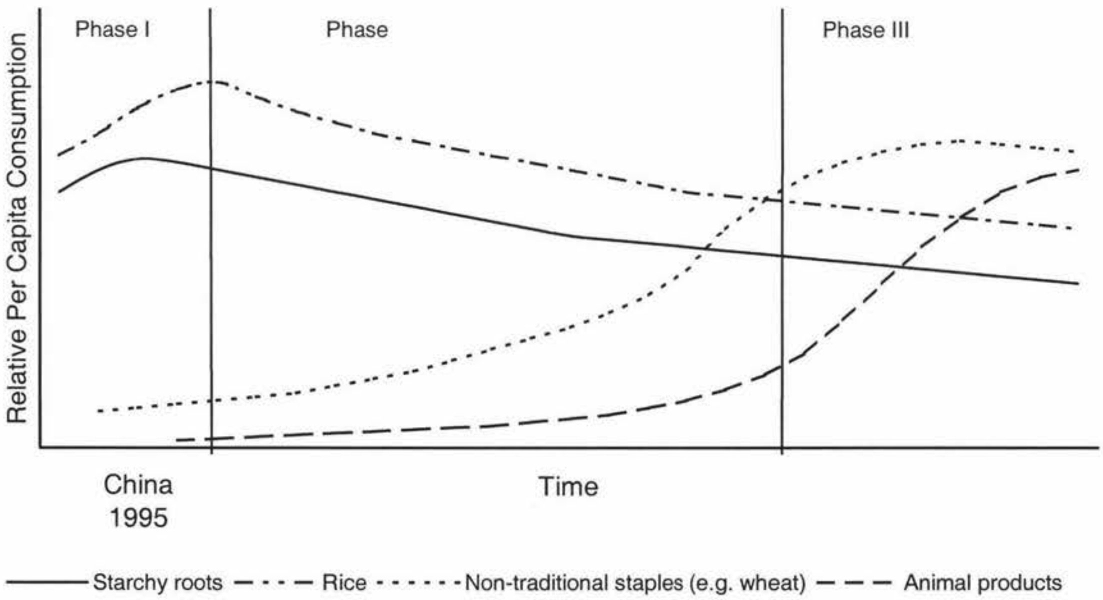

Figure 6.1: Phases of relative food consumption showing China's position in 1995. Adapted from Rae (1995).

If the population of China reaches 1.48 billion in 2025 as the UN Population Division estimates (Heilig, 1999), and meat consumption increases to more than 51 kg per capita by 2020 (World Bank, 1997a), annual meat production will need to increase by about 20 million tonnes to meet increased annual demand. This is a 36% increase over the current reported level of 55 million tonnes (OECD, 1999). However, there is considerable uncertainty in current consumption and production figures for meat and other agricultural goods (Lu, 1997).

Regardless of the potential discrepancies in the meat supply and demand balance, the demand for high quality meat products is likely to increase as disposable incomes continue to increase (the relationship between private expenditure and consumption of animal products is relatively strong (Rae, 1995)). To date, domestic production of meat has kept up with domestic demand, with just relatively small amounts of high quality meat being imported (426 thousand tonnes of meat, or just 0.8% of reported production, was imported in 1996 (FAOSTAT, 1999).

Currently in China there does not appear to be widespread appreciation of the differences in eating attributes between, for example, 5-year old bull and 2-year old steer. This point has also been recognised by AFFCO, a New Zealand meat processing company recently opening a joint venture processing plant in Chengdu, Sichuan Province. AFFCO's client services manager noted "Chinese are not generally familiar with prime beef development, the growth side of the equation, or the eating attributes of steer beef" (AFFCO, 2000). However, as ClearThinking.com (2000) reported, this is changing in the more affluent districts.

Economic development in China is likely to cause the large rural population to migrate to cities in search of work, as they become surplus to the needs of agriculture. Urbanisation in China promotes commercial agriculture and a shift away from subsistence type farming. Together with these changes, productivity will need to increase and a food industry will need to be established (Heilig, 1999).

Current production techniques are unlikely to supply meat of the required quality or volume in the future. This will be particularly so as the demand for non-traditional red meats continues to grow more rapidly than the demand for pork and chicken, although the white meats currently contribute a far greater proportion to meat consumption (Rae, 1995). Grain feeding of more livestock to increase the livestock slaughter rate may be possible, but there are concerns about China's ability to source sufficient grain to meet future demands (e.g., Brown, 1995; Ryan and Flavin, 1995; Brown, 1997).

Thus, new means of producing meat more efficiently need to be adopted, and a greater appreciation is needed on the part of farmers of the characteristics of meat from different classes of animal.

6.3 China's farm operating environment

Before 1979, China's agricultural policy was: to produce ample cheap food for urban residents, and to export farm products to earn foreign currency to pay for imported advanced technology and equipment to develop industries in urban areas (Tuan and Ke, 1999). However, more recently the policy focus has shifted towards (FAO, 1996; Chen, 1999; Tuan and Ke, 1999):

- Reduced support for urban industrialisation;
- Reduced emphasis on obtaining foreign currency via agricultural trade;
- More concern for growing farmer income;

- Greater emphasis on food security, self-sufficiency and market stability;
- Minimising state budget deficits and lowering state owned enterprise debt; and
- Protecting the environment.

China's food grain security policy continues to operate (as in many countries). The goals of this policy are: to support social and political stability; to serve domestic requirements for citizens in disaster areas; to serve as strategic stocks for national security purposes; and to stabilise grain markets and prices (Crook, 1999).

Agricultural policies implemented since 1979 can be generally classified into five categories: institutional and production; domestic market and prices; trade; input; and investment.

6.3.1 Institutional and production policies

The household production responsibility system (HPRS) was introduced in the early 1980s to provide opportunities for farm families to make their own economic decisions such as input allocation and private sale of surplus produce (Tuan and Ke, 1999). This policy gave the land use rights to individual households, but left the land ownership with the "collective".

Basic land policy in China is determined by the central government, but the real locus of land use decision-making now lies in the villages (OECD, 1999). Under the original HPRS, farmers were allocated land for a 15-year term. In 1993, due to pressure from farmers, the lease period was extended a further 30 years, applying to all land classes without changes made to the original allocation, unless so desired by the farm family. Land allocation is no longer based on the number of people per household (FAO, 1996; OECD, 1997; Chen, 1999). The main objective of the policy was to overcome the problem of farmers' unwillingness to invest in the land due the previously unstable land tenure policies (OECD, 1997; Tuan and Ke, 1999). The risk of uncertain land tenure encouraged farmers to work harder rather than invest in enhancing soil fertility or other improvements. This was because the return on labour was assured, although this return is only a temporary and short-term increase in output. However, the return on any investment farmers made, although having a more persistent and long-term effect on output for the investing farmer, was much less certain (Choe, 1995; Crook, 1997).

The policy was further revised in 1997 allowing the land use right to be sold by individual farm families provided that the original use of land is maintained (OECD, 1998). In 1999, the OECD suggested that the farmers in 70% of villages could transfer their land use right. At that time, the rental market for land represented only 3% of the total land area farmed. Most land rental transactions occurred between relatives (OECD, 1999). This low level of renting suggests that such transfers of land use rights remain complex and regulated, making it difficult for farmers to achieve production units of efficient size — economies of scale are still beyond China's farmers (Crook, 1997). However, 'external' economies of scale still exist, as households are able to borrow or share farm machinery and draught animals (OECD, 1999).

Chen (1999) stated that 90% of all villages had completed the 30-year extension of land contracts. There is perhaps a growing problem with some local officials shortening farmer contracts or forcing farmers to terminate their original contracts before they expire in order to maximise land contract fees (OECD, 1998; Hodgson, *pers. comm.,* 2000), even though reallocation of land or breaking of contracts by village officials is prohibited (OECD, 1997; Tuan and Ke, 1999). Similarly, political party connections may influence land allocation (McKinley, 1993).

In 1995, the Governor's responsibility system, the "grain bag " policy, was introduced for food security reasons, and makes provincial leaders ultimately responsible for meeting the grain requirement for the province (Tuan and Ke, 1999). Investment in agriculture increased as a result, but resource allocation became less efficient as each province strived for self-sufficiency. Provincial protectionism also increased, aggravating market imbalance problems at the national level (Tuan and Ke, 1999). A supplementary policy, the "vegetable basket" policy, was introduced for city mayors to secure the provision of non-staple foods (meat, eggs, milk, fish and vegetables) achieving similar outcomes (Tuan and Ke, 1999).

Rural finance reforms have occurred in China throughout the 1990s with rural credit cooperatives being reinstated and run by farmers for farmers. There has also been an increase in the volume of subsidised loans available (OECD, 1998; Chen, 1999). However, CIDA (1999) argued that lower income groups in many parts of China, especially northern and western regions, are still not served under the current financial system. This is largely due to the need to provide collateral for formal loans, and banks' unwillingness to include the poor because transaction costs are too high (CIDA, 1999). Under current law, it is not possible to create new financial institutions that are owned and managed by the people in the communities served (CIDA, 1999). Interest rate guidelines are set by the central government and must be followed by the rural credit cooperatives and NGOs operating micro-credit projects. The current interest rate ceilings do not enable self-sufficiency for these micro-credit projects (CIDA, 1999), which influences donor support for such projects.

The central government is also attempting to lessen the tax burden carried by rural households. This tax reduction policy was initiated in the early 1990s (FAO, 1996). In 1998, the government reiterated that farm family tax should not exceed 5% of net farm income (Chen, 1999; OECD, 1999).

6.3.2 Domestic market and price policies

In 1992, the central government announced that the "socialist market system" was the ultimate goal of economic reforms (Tuan and Ke, 1999), but food markets have been undergoing almost constant reform for the past 20 years.

From 1953 to 1985, China enforced a strict direct supervision over prices — unified purchase and marketing (Xu and Peel, 1991; Wang and Davis, 1992; Zhou, 1996) with procurement prices significantly below market prices and state selling prices also often lower than market prices in order to subsidise urban residents[20]. In 1978/79, the government reduced the number of products to which the compulsory purchase applied (Xu and Peel, 1991; Wang and Davis, 1992). In 1985, the system was adjusted slightly to create the 'contracted purchase' system, which allowed farmers to sell freely any surplus produce after meeting all contracted requirements, and procurement prices were lifted (Xu and Peel, 1991; Wang and Davis, 1992;

[20] Zhou (1996) provides an estimate that 800 billion RMB has been extracted from farmers by the procurement system and other policies.

Tuan and Ke, 1999). Government procurement and fixed retail prices were eliminated for fruit, vegetables, and livestock products in 1985, which saw rapid expansion in those sectors (Tuan and Ke, 1999).

A price support programme was implemented in the mid-1990s because the market price for grain (corn, wheat and rice) fell below the government quota price, creating government debt, though the government did not take ownership of the grain, but rather encouraged the marketing enterprises to purchase more grain.

In 1998, China returned to a state monopoly over grain procurement in an attempt to control grain supply at the retail level so that the market price would rise above the protection price paid by the government (Tuan and Ke, 1999). Tuan and Ke (1999) suggested that such a policy could not work and that the chaotic situation would continue because *"China has simply produced too much grain over the past three years* (1996-98) *and has run out of storage space".*

6.3.3 Trade policies

Foreign trade in agricultural commodities is controlled by the central government (Tuan and Ke, 1999). Domestic and foreign trade policies have caused some instability in foreign trade, with large differences between years in amounts of produce imported and exported, during the 1990s, which has tended to increase domestic price fluctuations (Carter and Rozelle, 1997; Tuan and Ke, 1999).

Tariffs for all products, including agricultural goods have been progressively lowered since 1992 as part of China's bid to accede to the World Trade Organisation[21] (OECD, 1998). Export subsidies are also in the process of being eliminated, however Tuan and Ke (1999) considered China's agriculture to be subsidised in that the central government plays such a major role in procurement, pricing and trading of agricultural goods[22].

[21] In 1992, China's overall average tariff rate was 43.2%. By 1997, the overall average tariff rate was 17%, while the overall average tariff rate for agricultural products was 21.2% (Tuan and Ke, 1999).

[22] Government authorities control wheat, rice, corn, sugar, vegetable oil and tea marketing (Crook, 1997). Cotton trading was liberalised in 1999 (Tuan and Ke, 1999).

6.3.4 Input policies

Agricultural inputs were previously controlled by government. However, the marketing of fertiliser, machinery, pesticides and fuel has been largely liberalised, with the production and distribution of these goods exempt from value-added tax (Tuan and Ke, 1999). Small fertiliser producers are allowed to sell freely, as are larger factories, once government quotas have been met. Price controls are exercised for fertiliser (World Bank, 1997a).

6.3.5 Investment policies

Government investment in agriculture has tended to lag well behind that spent in industry (Crook, 1997; Tuan and Ke, 1999), but has increased again with the state allocating 120 billion RMB from the national budget for agriculture investment in 1998 (Chen 1999). Much of this recent investment has been directed towards the revitalisation of water and irrigation systems (OECD, 1997; Chen, 1999).

Investments in agricultural research, extension and technology, and in rural infrastructure are still considered inadequate (FAO, 1996; Crook, 1997; Tuan and Ke, 1999). However, Chen (1999) argued that the government was rapidly expanding investment in agricultural research and extension. It is expected that farmers will be required to continue their contribution to infrastructure development, building roads, dams, bridges and irrigation systems[23] (Crook, 1997).

6.4 Pastoral livestock system development in Southwest China

6.4.1 Grasslands and livestock production in Southwest China

The southwest provinces are Sichuan, Guizhou, Guangxi and Yunnan. Mountains dominate the topography of the region. However, there are some quite large plateau areas. Soils are predominantly formed on limestone, and those soils on the plateaux are quite similar to New Zealand's yellow grey earths and yellow brown earths (Bruce-Smith, 1990). The native pasture species are generally of low nutritive value and low palatability (e.g., bladey grass, *Imperata cylindica*) and there are a large number of broadleaf weed species.

[23] Government policy states that rural labourers should do 5-10 days of rural voluntary work and 10-20 days of work for labour accumulation each year (FAO, 1996).

The region possesses a large number of cattle[24], but the cattle size is small resulting in low meat output (Zhang et al., 1997). There is considerable potential in this region to develop beef, goat, and sheep farming for the production of red meat (Ren and Jiang, 1999; Zhang et al., 1997). To realise this potential, the large pastoral areas and vast wastelands need to be sown in more productive pasture species, and cattle breeds need to be improved (Zhang et al., 1997). Improved grazing management is also required.

Table 6.2: Changes in Southwest China's contribution to China's beef production. Adapted from Zhang et al. (1997).

Region	Year	Cattle No.		Slaughtered No.		Carcass Weight (kg)	Beef Output	
		(000 head)	% of China	(000 head)	% of China		(000 tonnes)	% of China
SW China	1980	22,780	32	745	22	72	54	20
	1990	22,790	22	1,565	14	96	149	12
	1995	33,484	25	3,899	13	100	389	9
All China	1980	71,676	100	3,322	100	81	269	100
	1990	102,884	100	10,883	100	124	1256	100
	1995	132,060	100	30,499	100	136	4154	100

6.4.2 Contribution of livestock farming to rural incomes

Throughout China, farmers raising beef cattle are generally richer than those without beef cattle (Zhang et al., 1997). Livestock industry development has also led to the establishment of downstream enterprises, such as leather tanning, that are also located in rural regions (Zhang et al., 1997).

In Yunnan Province, the contribution of livestock farming to farmer incomes has increased from 18% in 1978 to 30% in 1998 (Yang, 1999). During this period, farmer incomes have risen considerably as noted above, thus, on average, livestock is providing a larger share of a larger total income for farmers.

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[24] The predominant breeds of cattle are localised Yellow Cattle (*"Huang Nui"*).

6.4.3 History of pastoral livestock system development programmes

The first large-scale pastoral livestock system development project was in Yunnan Province. The project (Yunnan Livestock and Pasture Development Project), run in two phases, was a joint Australia–China programme of technical co-operation from 1983 to 1990. The first phase of the project focused on component research (pasture species evaluation and fertiliser trials) and established several demonstration farms. The second phase concentrated more on extending appropriate aspects of the knowledge gained from the research programme to villagers in several key counties (Bruce-Smith, 1990).

A similar project, the Dushan Seed Farm Project in Guizhou Province, ran from 1983 to 1988. This project involved pasture species evaluations and fertiliser trials. After the initial trials, it was found that Maku Lotus (*Lotus peniculatis*), Wana cocksfoot (*Dactylis glomerata*), and red clover (*Trifolium pratense*) were well adapted to the local soils and climate (Rolston *pers. comm.,* 2001). Seed crops were then established for perennial ryegrass (*Lolium perenne*), cocksfoot (*D. glomerata*), white clover (*Trifolium repens*), and red clover (*T. pratense*), to determine suitable cultivars and management practices for seed production (Rolston et al., 1993). Livestock systems were also established on land unsuitable for seed crops.

A second large-scale project began in Guizhou Province in 1989 (Agro-grassland Systems Development Project) with funding contributions from UNDP, and the New Zealand and Chinese governments. The Gansu Grassland Ecological Research Institute (GGERI) (domestic consultants who have worked in Guizhou since 1983), and Massey University (international consultants), provided technical input. The purpose of this project was to develop sustainable, low cost, low input pastoral livestock farming systems. Three systems were established for demonstration: dairy cattle, sheep, and beef cattle (Chu et al., 1999; Ren and Jiang, 1999).

The GGERI extended the project into Yunnan Province in 1996, with continuing support from Massey University, under the National Ninth Five Year Plan. The focus of this extended project was further demonstration and extension of the skills and knowledge developed in Guizhou.

These projects aimed to assist local people realise the productive potential of the vast pastoral areas in the Southwest of China (Sichuan, Yunnan and Guizhou Provinces). The Southwest provinces' potential for livestock production is considerable because of the favourable climate for pasture and crop production, and the lower reliance on crop residuals for winter fuel (Chu, 1997).

6.4.4 Issues raised

The dominant issue raised in the many reports and papers written by international consultants is that farmers should be given a greater role in the development process, echoing a recommendation of development practitioners and development agencies worldwide. The lack of farmer participation in the Southwest China Programmes meant that although technology was successfully extended to technicians, the targeted final users (farmers) adopted very little of the introduced technology. Chu et al. (1999) concluded that farmers should have been involved earlier in the projects to establish farmer-owned demonstration farms. Matthews (1992) suggested that demonstration farmers would be the key to the long-term success of pasture-based systems in Southwest China.

The attitudes of extension and project staff to farmers and new ideas was also raised as an important issue (Matthews, 1992). Extension workers failed to appreciate farmer knowledge and skills, and claimed that farmers did not listen to them. Project staff also tended to say that the new idea would not work in China without considering the main issue of how it can be made to work. Too many bureaucratic units were involved in the management of the projects, and farmers were left unrepresented. Each faction had their own agenda and targets to be met without any mutual purpose, and this resulted in farmers, the supposed focus of the projects, being neglected (Matthews, 1992). Extension staff often did not know what it was they wanted to demonstrate, and when a demonstration farm was established, the benefits of the new system were not clearly illustrated (Matthews, 1992). Information collected and knowledge obtained tended to be held by different factions within project management, and was closely guarded making collation and extension difficult (Matthews, 1992). Technicians and extension staff spent insufficient time contacting farmers, and this affected the level of trust and respect between farmers and technicians (Rolston et al., 1995). The lack of technicians carrying out extension activities at the village level is relatively common (Huang, 1998).

Chu et al. (1993) identified six critical factors affecting the success of technology transfer and development projects in China:

(i) An effective administrative system capable of removing “road blocks”;

(ii) Guaranteed credit facilities for farmers to support their development investments;

(iii) A team of dedicated technical personnel who understand local conditions and are capable of adapting external technologies to fit local needs, while appreciating traditional methods of production;

(iv) Ability to identify and choose the most appropriate technology, and focus on transferring and adopting the principles underlying the technology rather than trying to apply the technology directly without adapting to local conditions;

(v) Selection of highly motivated and progressive farmers who will be the local advocates for the new technologies, and demonstrate the benefits and principles of these technologies; and

(vi) A good economic return to participating farmers and those farmers who adopt new technologies.

In a later evaluation of the project, Chu et al. (1999) identified two further issues related to point (iv) above. First, the inadequate supply of resources when they were required, and second, the lack of processing facilities and market development. This second issue could not be resolved because of funding agent inflexibility. The lack of funding and expertise in processing and marketing has affected farmer development through both market and price uncertainty (Chu et al., 1999). Narrow project focus has tended to be common in agricultural projects. Rolston et al. (1995) also highlighted the need to develop opportunities beyond the production of raw food materials.

Ren and Jiang (1999) suggested a long-term development perspective was necessary, oriented towards the establishment of a "complete grassland production system", and that "in certain ecological-economic zones in the south of China ... conditions are suitable for the development of up-stream and down-stream industries".

6.4.5 Technologies adapted and extended

Initially, the main type of technology trialed and extended was improved pasture species with many evaluation trials being carried out at different locations in both Guizhou and Yunnan Provinces. Fertiliser trials were also carried out, along with soil fertility evaluations to determine the most limiting nutrients for legume-based pasture production and the response to applications of these limiting nutrients (Bruce-Smith, 1990; Ren and Jiang, 1999).

Pastoral farmers in Southwest China traditionally house livestock at night. This causes considerable transfer of nutrients from the pasture areas to crop areas and results in lower pasture productivity. Recognition of the nutrient losses from pasture and the need to establish improved species led to the development of sheep night penning (see Section 7.3.7) as a technique for raising soil fertility, preparing the soil for sowing, and establishing new pastures (Jiang et al., 1999). Sheep night penning is a low cost technique for pasture improvement. However, there are other indirect costs such as lower crop yields due to manure being channelled away from the cropping land (Jiang et al., 1999).

Demonstration and smallholder pastoral livestock systems have been established (sheep, beef, and dairy systems), all of which have resulted in large (6–10 fold) increases in annual farmer incomes (Chu et al., 1993; Chu et al., 1999; Matthews et al., 1999). Such systems were built on New Zealand farming principles, particularly pasture and grazing management principles. The role of maintenance fertiliser is poorly understood in China (Matthews et al., 1999).

Understanding of pasture management is still at quite a low level, with overgrazing severely constraining pasture productivity, pasture persistence, animal intake, and animal performance (Matthews et al., 1999). Therefore, the need for further assistance in this sector remains quite significant if productivity is to be markedly increased and the potential of this vast region is to be realised for the local communities.

6.5 Available technologies and system production potential

The technologies described here have been available in China for long periods of time and are based on research carried out within previous pastoral development studies in Southwest China. These innovations are not listed in any order of priority.

6.5.1 Phosphorous fertiliser

China, and Yunnan in particular, produces a very large quantity of phosphorous fertiliser. Approximately 90% of the 2.5 million tonnes of phosphorous consumed in China annually is produced domestically (International Fertiliser Association, 2001), thus phosphorous fertiliser is readily available to farmers. The bulk of phosphorous fertiliser is in the form of *Gaimeilin*, a calcium magnesium phosphate (9% P, performing similarly to superphosphate in New Zealand) manufactured by fusion of dolomite and rock phosphate.

The pasture yield response to phosphorous fertiliser is well understood in Southwest China, as phosphorous fertiliser trials have been carried out since 1983 in both Yunnan (Bruce-Smith, 1990) and Guizhou (Rolston pers. comm., 2001).

6.5.2 New pasture species

Pasture species have been trialled at many sites in Yunnan and Guizhou Provinces since the early 1980s when New Zealand and Australian scientists first became involved in pastoral and livestock system development in the region. Since that time, there has been a proliferation in the availability of pasture and turf seeds, some species suitable and some not suitable, mainly through privately owned seed companies which are often owned by AHB or Department of Agriculture employees.

6.5.3 Fencing

Subdivision allows for better management of pastures: less overgrazing, less selective grazing, less under-grazing and less within-farm nutrient transfers by allowing the livestock to be easily restricted as to the area grazed at any time. Subdivision also allows for better livestock performance: pasture covers can be managed to offer optimum pasture allowances and high pasture quality, as well as improving the utilisation of pasture. Increased subdivision allows the farm to be divided into grazing areas based upon land class, aspect, pasture species and other physical characteristics.

6.5.4 Improved sheep genetics

Yunnan Province has several sheep breeding farms producing rams, which are available for purchase. Both Cormo and Romney breeds are available. All the rams available for sale weigh over 80 kg and average 90–95 kg, offering considerable opportunity to boost offspring growth rate and mature liveweight.

6.5.5 Sheep night penning

The sheep night penning technique of improving pasture was developed after a series of experiments conducted from 1990 to 1995 in Guizhou Province (Jiang et al., 1995a, 1995b, 1995c; Li et al., 1995). Sheep are penned in a small area on indigenous pasture at night at 4–8 sheep nights/m^2. Nutrients excreted at night in dung and urine, that would otherwise be lost from the pastoral sub-system in animal houses, are applied to the area as a replacement for capital fertiliser in pasture establishment. Before the last penning night, pasture seed is sown and the subsequent treading ensures adequate seed-soil contact.

Initial pasture yields are high, but decline rapidly over time. Soil nutrient status also declines rapidly over time (Figure 6.2), suggesting that maintenance fertiliser should be applied to night penned areas to balance the nutrient losses. Although the technique is easy to implement and low cost[25], it is not a suitable replacement for cultivation, but rather a technique for use in difficult to cultivate sites, because the technique only allows a very small area to be developed each year. For example, a farm stocked at 4 su/ha, using 6 sheep nights/m^2 for 100 days a year would only improve 0.67% of the total farm area per year. Additionally, crop demand for manure will limit the time available each year for sheep night penning.

[25] Jiang et al. (1995c) estimated the cost of night penning to be 20% of that of pasture establishment via traditional cultivation.

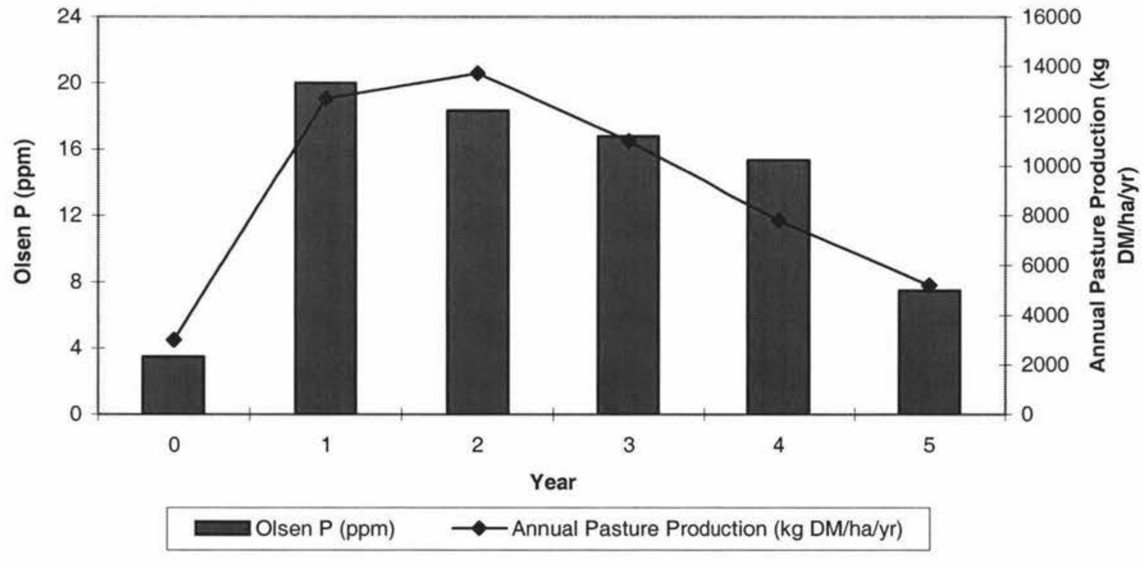

Figure 6.2: Olsen P and annual pasture production under sheep night penning over time. Adapted from Jiang et al. (1995a). The linear correlation between annual pasture production and soil Olsen P for this trial is $r^2 = 0.907$.

6.5.6 Controlled mating and spring lambing

Previous research from other development projects (e.g., Jiang et al. (1993) in Guizhou) showed that lambing could readily occur in spring, and that such a system better matched pasture demand with supply.

6.6 Extension services in China

The national agricultural extension system belongs to the government. Agricultural extension organisations have existed since 1949 when the Ministry of Agriculture (MOA) was established. The administration of extension is split into fields — crop, fisheries, livestock, and machinery (Fan and Pardey, 1992; Huang, 1998). A similar structure prevails from the national level to the county level. At township and village level, extension roles for different sectors of agriculture are combined (Huang, 1998). Even though different levels of the extension agencies exist at each administrative level, the higher echelon agency does not have administrative control over lower echelon agencies — the linkage is purely professional (Fan and Pardey, 1992; Huang, 1998). For example, a provincial extension agency does not have direct control over a prefecture extension agency, rather the provincial Department of Agriculture has control over the prefecture Department of Agriculture, which has control over the prefecture extension agency (Figure 6.3). The county is the focus of extension (Fan and Pardey, 1992; Huang, 1998). Huang (1998) contended that the extension system has not been completely established, especially at township and village levels, and that frequently no village level technicians exist and village leaders often substitute themselves as technicians.

Huang (1998) also noted that because of the fragmented nature of the extension system, it is common for lower-echelon agencies to receive orders from two or more higher-echelon agencies each requiring a report, and sometimes these commands are conflicting. The conflicting demands give extensionists many difficulties, but, on the other hand, they provide the extensionists with an excuse for not following orders (Huang, 1998). Huang (1998) also stated that there is a long history in China of people in dilemma positions waiting and not taking any action, behaviour that is attributed to Taoism. The main principles of Taoism are "do nothing, and nothing will be done" and "do not take the lead in planning affairs or you may be held responsible". Huang (1998) contended that Taoism philosophy encourages extensionist inaction.

Huang (1998) in his study of extension workers in Hebei Province's cotton growing districts found that many extension workers were often in a role conflict between farmers and the government:

> *"The farmers are interested in new technology and market information and they are not interested in growing cotton, but the government likes us to advise farmers to grow cotton; they want different things from us."*
>
> County extension agent (Huang, 1998: pp 79).

Other extension agents comments reported by Huang (1998) suggest that many extensionists have little interest in helping farmers improve their livelihoods, but are rather focused on bettering their own position:

> *"Nowadays, the extension agents have no enthusiasm for their work... Everyone earned a little before ... I had knowledge, I was very much respected by people. Now, so many people without education can earn a lot ... I feel very vexed."*

"I do not care about the government and the farmers and just want to earn more money."

"I do not like my job here ... At least I have a safe job with all kinds of social welfare."

"I am not interested in working as an extension agent."

County extension agent (Huang, 1998: pp 79 - 80).

Extension agents have three main roles (Huang, 1998):

(i) To promote government bureaucratic missions such as production targets of specific crops and animals;

(ii) To promote technical missions such as projects similar to the project within which the researcher was employed; and

(iii) To provide services to farmers such as technical support.

Fan and Pardey (1992) also noted the very weak linkages between research and extension services: at the provincial level extension is the domain of extension centres, while research is carried out by provincial academies of agriculture and agricultural universities and colleges. Fan and Pardey (1992) suggested that this led to unnecessary competition for research funding and duplication of research.

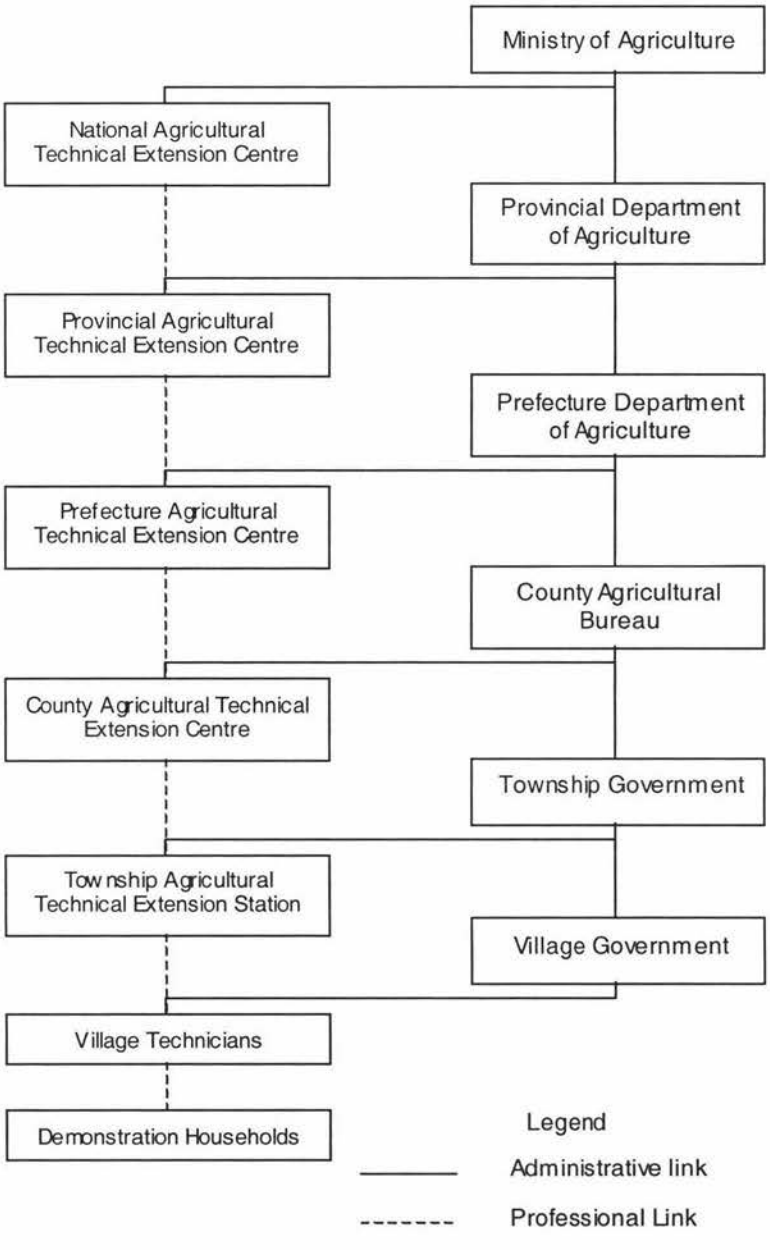

Figure 6.3: Organisational structure of the agricultural extension system in China. Adapted from Fan and Pardey (1992) and Huang (1998).

6.7 The study area

Yunnan Province is located in the southwest of the Peoples' Republic of China, bordering Myanmar to the west, Vietnam and Laos in the south, Guizhou Province and Guangxi Zhuang Autonomous Region in the east, and Sichuan Province and Tibet (XiZang Autonomous Region) to the north (Figure 6.4). Yunnan is about 39 million ha in area and has a population of 41.44 million (NBS, 1999). There are many ethnic minorities in Yunnan — of the 56 ethnic groups in China, 27 inhabit Yunnan.

Figure 6.4: Map of China showing provinces, autonomous regions and municipalities.

Literacy in Yunnan is low[26], particularly in rural areas (Cook and White, 1998). Only half of all the farmers studied in this project had any formal education, and the remainder had between two and five years primary schooling.

The topography in Yunnan is dominated by limestone mountains and large rivers. The eastern part of the province contains a large, river-dissected plateau, which extends into neighbouring Guizhou Province. This plateau, the Yun-Gui Plateau, ranges in altitude 1800 m to 2500 m above sea level. Soils on the plateau are

[26] In 1998, 25.5% of people in Yunnan were illiterate or only semi-literate (China Yearbook, 1999). Illiterate and semi-literate population refers to people aged 15 years and older who are unable to read or have great difficulty in reading (can read less than 1500 characters) (China Yearbook, 1999). This level of illiteracy is unchanged from a 1990 State Statistics Bureau survey reported in Cook and White (1998).

Acrisols (FAO-UNESCO classification; CPGCC, 1985); they are predominantly formed on limestone and have a yellow/red colour. These soils have similar characteristics to New Zealand's Yellow Grey Earths and Yellow Brown Earths (Bruce-Smith, 1990). Rainfall (1225 mm) on the plateau is concentrated in summer, and again in early autumn (Figure 6.5). These monsoon rains sometimes start early in May and in other years do not start until July. Winter and spring are very dry. Temperatures increase rapidly in spring, and remain high until early autumn. Temperatures can be very low in winter (below 0° C most nights in December and January) with several heavy snowfalls likely each year.

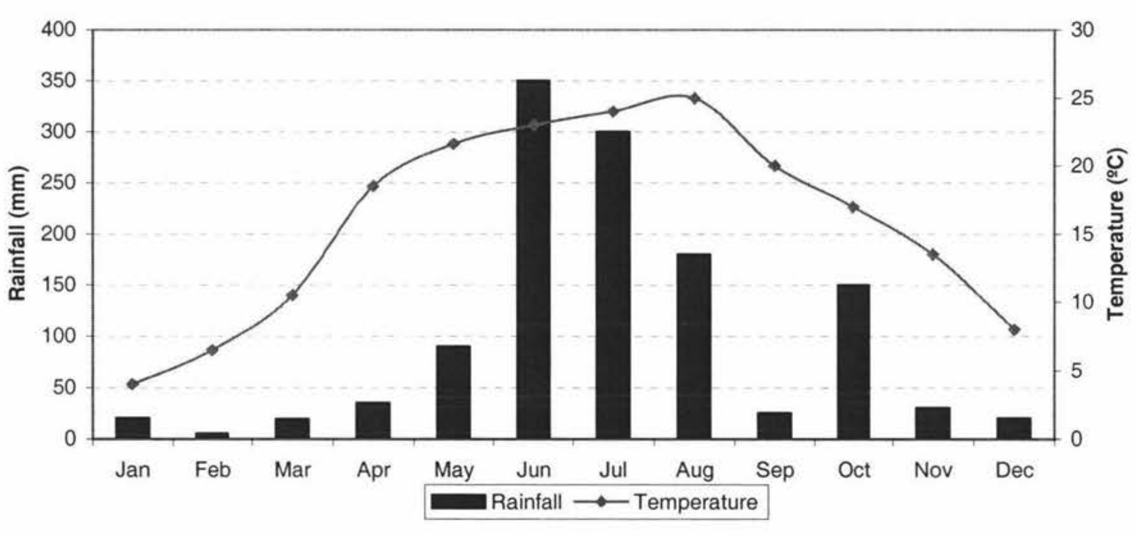

Figure 6.5: Estimated mean monthly rainfall and 3 pm temperature for Bei Da Ying. Estimated from data in the China Statistical Yearbook 1999 for Kunming City and Guiyang City, both also located on the Yun-Gui Plateau.

Pastures are dominated by indigenous pasture species, especially *Imperata cylindrical* and *Heteropogon contortus*. Many broadleaf weed species are also dominant in some areas.

Farmers in the eastern pastoral regions of Yunnan Province derive their income and consumption from pastoral livestock farming (red meat and wool for sale, cattle/buffalo are also used for cultivation), pork and poultry production (largely for personal consumption), and cropping (various cereals – for family consumption, livestock feed and sale to meet government grain quotas if necessary; and cash crops such as potatoes, rapeseed, and tobacco). There are significant flows of energy and nutrients between the various sub-systems. Two of the most significant are the heavy reliance on supplementary feeds in winter for the ruminants normally grazing pasture (most of which are grown on each farm family's own arable land) and the transfer of nutrients from the pasture areas to the arable areas in the form of manure collected from livestock housed at night.

The researcher was posted as a pastoral livestock systems specialist from April 1998 to August 2000, based in Qujing City. The purpose of the post was to partially fulfil the technical support and training contracted to Massey University within the National Ninth Five Year Plan pastoral development project jointly managed by the Animal Husbandry Bureau of Yunnan Province (AHB) and the Gansu Grassland Ecological Research Institute (GGERI). The project was called the "Yun-Gui Plateau Sustainable Pasture Technology Research and Development Project"[27]. Specifically the role entailed:

(i) Providing technical support to AHB technicians at provincial through to village levels;

(ii) Providing technical support to the GGERI research team based in Qujing City, including trial design and management, monitoring, technician training and data analysis;

(iii) Assisting in the establishment of improved pastures on 8000 mu; and

(iv) Providing extension training to pastoral livestock farmers in the project area.

Qujing Prefecture is 3.25 million ha, and in 1998 the population was 5.7 million (Qujing Trade and Tourist Map, 1998 [in Chinese]). In 1998, Qujing Prefecture produced one third of Yunnan Province's tobacco, more than any other region in China. Other major agricultural activities include rapeseed oil, cereals, silk, and pork (Qujing Trade and Tourist Map, 1998 [in Chinese]). Qujing Prefecture has 380,000 mu of mainly indigenous pasture, more than any other prefecture in Yunnan (Wu *pers. comm.*, 2000).

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[27] Referred to as the AHB/GGERI project in remainder of this study.

The study areas were all in the Qujing Prefecture, and were all project sites. The three sites used in the research were Bei Da Ying Village, Yunnan Province Sheep Breeding Farm, and Lang Mu Mountain (Figure 6.6).

(i) Bei Da Ying Village – a small village located in the Xun Dian Hui and Yi Minority Autonomous County about three hours drive from Qujing City. This site is a high-altitude (2400 m) plateau with undulating terraces. Large parts of the pasture area surrounding the village have been renewed unsuccessfully five or six times in the 15-year period prior to the commencement of the project at the end of 1997. There were 19 Bei Da Ying private farmers associated with the project during the researcher's two-year post. These families were predominantly Han and Miao nationality. As part of the project, a demonstration farm (285 mu) and a pasture and soil research centre were also established at Bei Da Ying. The demonstration farm lambed in spring, and carried an increasing number of cattle. The farm was subdivided into 13 paddocks and was being progressively regressed over three years.

(ii) Yunnan Province Sheep Breeding Farm – also located in the Xun Dian Hui and Yi Minority Autonomous County about one and a half hours drive from Qujing City. This site is owned by the Yunnan Province Animal Husbandry Bureau and is one of the key livestock breeding centres for the province. The Breeding Farm owns all livestock and land. Eleven farmers (Han) are employed by the Breeding Farm to manage flocks of 40-60 ewes for breeding rams for sale throughout the province, and producing wool to supply the farm's wool scour and blanket manufacturing plant. Romney and Cormo (a fine woolled breed resembling New Zealand's Corriedale) rams are bred and surplus hoggets are sold for meat. The farm is predominantly medium hill country, at an average altitude of 2400 m, with small undulating areas used for cropping. Most pasture had been established in the 1980s and had received phosphorous fertiliser regularly throughout most of the 1990s.

(iii) Lang Mu Mountain – located 25 km east of Qujing City, but taking about one hour to travel from the city. Most of the pasture areas are rolling hills at an average altitude of 2300 m. Large areas were renewed in 1991 as part of another development project. The remainder of the mountain was planted in pine forest, left as indigenous pasture, or cropped and allowed to return to indigenous pasture. This site is owned by Yan Jiang Township and was leased for the duration of the project. The area was split into four separate farms each managed by a different project participant group: GGERI, Qujing City AHB, Qilin Region AHB, and the Yan Jiang Township. The contracted purpose of these farms was to demonstrate profitable and sustainable pasture-based livestock production systems, and to renew any indigenous pastures. These farms carried goats and cattle, with the goat:cattle ratios varying across the four farms from no cattle, through to 50:50 on the GGERI farm. The GGERI managed farm was subdivided into 13 paddocks. These farms were managed by technicians from the various organisations, assisted by farm workers who carried out most of the manual work.

Figure 6.6: Map of Yunnan Province showing Kunming City, the provincial capital; Qujing Prefecture (the shaded area); Qujing City, the prefecture capital; Xun Dian Huizu Yizu Autonomous County and Bei Da Ying Village (the case study). Lang Mu Mountain is not shown, but lies 25 km east of Qujing City.

The case study group that this study is largely based upon is the 19 small-scale mixed cropping and pastoral livestock farm families at Bei Da Ying Village in the Qujing Prefecture of Yunnan Province, Peoples' Republic of China. Additional qualitative data was collected from the 11 farm families from the Yunnan Province Sheep Breeding Farm in Xun Dian County.

7 Research Methodology

7.1 Choice of research strategy

Yin (1994) defined five research strategies: experiment, survey, history, archival analysis and case study. Patton (1987) also identified two other strategies, observation and participation, because he believed there are limitations to how much can be learned from what people say, especially in complex situations. Yin (1994) then defined three criteria by which research strategy can be selected: the type of research question asked (how, what, where, who and why), the extent of control the researcher has over behavioural events and the degree of focus on contemporary, as opposed to historical events, (Table 7.1). Research questions that ask "what" can pertain to exploratory inquiry, or a form of "how many" or "how much". If the question is exploratory, like the question in this study, then any of the five research strategies can be used (Yin, 1994). The research is about what are the opportunities and constraints for farmers to increase their income through pastoral livestock systems. Control over behavioural events is not required for much of the research because opportunities and constraints can only be studied in a natural setting. However, for the development project as a whole to quantify the magnitude of these benefits, it was essential that some controlled experiments be run to provide such data. These experiments are used to support and contribute to this study. The focus of this study is largely contemporary as opposed to historical, although knowledge of past events is vital in understanding the context in which the study is set.

Table 7.1: Criteria for selecting different research strategies (Yin, 1994).

Strategy	Form of research question	Requires control over behavioural events?	Focuses on contemporary events?
Experiment	How, Why	Yes	Yes
Survey	How, What, Where, How many, How much	No	Yes
Archival analysis	Who, What, Where, How many, How much	No	Yes/No
History	How, Why	No	No
Case study	How, Why	No	Yes

In designing a research methodology it is necessary to consider the type of information required, how that information will be used, the readiness with which it can be collected and the credibility and reliability of that information (Patton, 1987; Chen, 1997; Datta, 1997). The type of information can be intensive and contextual (e.g., understanding of farmer and other supply chain participant beliefs and feelings, and of reasons for adopting or not adopting various technologies) or may be extensive and precise (e.g., understanding of the actual utilisation and adoption of farmer technologies and the impact of those technologies) (Chen, 1997; Datta, 1997) (Figure 7.1).

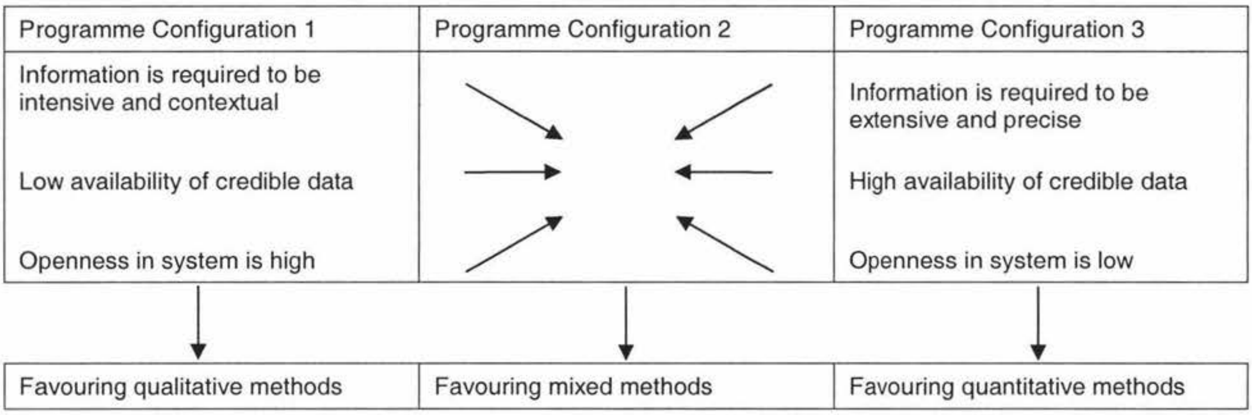

Figure 7.1: Programme configuration and choice of research methods. Adapted from Chen (1997).

Although the farm family systems studied at Bei Da Ying operated within a wider environment, the project demonstration farms adjusted or reacted only minimally to changes in this operating environment. This lack of adjustment was due in part to inflexible and sometimes inappropriate project designs and targets, and also to funding and bureaucratic constraints. The GGERI/AHB project also had a relatively narrow focus, considering only the pastoral aspects of the farm systems being studied, and neglecting cropping, forestry, fruit, white meat producing livestock and fish, and, most importantly, markets and people. These two factors (i.e., lack of adjustment and narrow focus) have had a significant influence on the amount and nature of data available for this research. Thus, a large proportion of the information on the integrated systems is under-reported, or only able to be based on the researcher's biased observations.

Based on Yin's (1994) typology, any one of the five research strategies, or a mix of two or more, would be appropriate. Further, the complexity of the situation being studied suggests that observation and participation are also appropriate (Patton, 1987). The characteristics of the research situation described above indicate that a mixed methods research design was the ideal approach for pragmatic reasons (Chen, 1997; Datta, 1997; Greene and Caracelli, 1997), recognising that the required methodologies needed to be situationally responsive and flexible in order to generate a full understanding. The mixed methods design using methodological pluralism could be expected to offer better understanding and results than any one single research method (Moris and Copestake, 1993).

Four other issues further support a mixed methods design:

(i) Trustworthiness of official data – a well-known and reported problem with many official statistics in China, especially agricultural and livestock data, is that these numbers are usually collected to assess the performance of bureaucrats and politicians at all levels relative to some higher level targets (e.g., Lu, 1997).

(ii) There is frequently a lack of trust between farmers and extensionists, interpreters and scientists. The perception of the role of a foreigner is also uncertain, though this relationship soon involved trust. The researcher trusted farmers and their responses, and the researcher perceived that farmers trusted him.

(iii) Translation – translator understanding and interpreting of questions and suggestions is not entirely certain even after considerable time working with the researcher, although this improved with time. Similarly, understanding and interpretation of responses can be uncertain. Local dialects further confound the situation.

(iv) The research was aimed at offering possible opportunities for solving a set of problems. In doing this, the constraints to overcoming those problems were highlighted, as were the associated threats and opportunities.

The methods used in this study are: survey, interview, observation and participation, archival analysis (secondary data), and experiments, pulled together to create a detailed and descriptive case study. Patton (1987) considered such an omnibus strategy that simultaneously combines many methods to be a participant observation methodology strategy.

7.2 Research design

In the Introduction (Chapter One), the research question and four objectives were stated. However, these objectives are still relatively broad and contain many components. Accordingly, a list of sub-objectives or questions was established to guide and assist in structuring the research process. These sub-objectives (questions) are provided here under the respective objectives, together with the research methods used to obtain data to answer the questions (Table 7.2).

The research design was essentially an exploratory case study (Yin, 1994) in that the issues, problems and opportunities facing pastoral livestock farmers in Qujing Prefecture are identified and described using a wide range of data sources and participant observation (Patton, 1987) or mixed method (Greene and Caracelli, 1997) research methodology. Comparison with theories of development, extension, adoption of innovations and supply chain management allowed these issues to be more clearly defined and explained. Possible solutions to problems, and means of taking advantage of opportunities were explored during the two-year posting in Yunnan Province, again using a wide range of data sources.

In case study research, the unit of analysis is the researcher's basic definition of the case (Patton, 1987; Yin, 1994). The case in this study is small-scale mixed livestock and cropping farm families in Bei Da Ying. Therefore, the unit of analysis is this group of farm families at Bei Da Ying, but it is possible to generalise and draw conclusions from the studied case that are relevant to a wider group of farm families throughout eastern Yunnan (Patton, 1987). However, this unit of analysis is embedded (Yin, 1994) within a much broader population because the findings may have implications for the development of sustainable rural livelihoods in many parts of the developing world.

Table 7.2: Research objectives, questions providing the framework for the research process, and the methods employed in the research.

Objective	Question	Methods
To describe the current red meat supply chain in Yunnan.	How are farmers currently producing red meat?	Focus group discussions Key informant interviews Observation Researcher participation (monitoring/measurement)
	How much income do farmers currently earn?	Focus group discussions Key informant interviews
	What are farm family values and goals?	Focus group discussions Key informant Interviews Farmer survey
	What are the current markets for agri-products?	Focus group discussions Key informant interviews Informal interviews Observation
	What are the current annual price patterns and between year variations?	Focus group discussions Key informant interviews
	How are livestock processed and distributed?	Key informant interviews Observation
	What are the buying habits, demands and expectations of Chinese consumer groups and how are these changing?	Key informant interviews Observation Secondary data review
	What aspects of their farm production systems and businesses do farmers believe/perceive they can control or influence?	Key informant interviews Farmer and technician survey Observation
To investigate and evaluate ways of increasing pasture-based red meat productivity using proven New Zealand pastoral livestock system technology.	What are the current constraints to higher pasture production and red meat output?	Key informant interviews Focus group discussions Observation
	What are the current problems in pasture and red meat production sub-systems and the wider systems with which they interact?	Key informant interviews Focus group discussions Observation
	What technologies are available to increase pasture productivity and red meat output?	Key informant interviews Observation Secondary data review Researcher participation
	What are the benefits and other adoptability characteristics of these technologies?	Key informant interviews Experiments and physical monitoring Observation Researcher participation
To identify internal and external factors influencing technology uptake at the farm level.	What are the incentives (from the external operating environment) for farmers to invest in, and adopt these technologies?	Focus group discussions Key informant interviews Observation Secondary data review

	What are the capabilities and opportunities necessary to encourage investment in and adoption of new technologies?	Focus group discussions Key informant interviews Observation Secondary data review
To identify external factors affecting the increase in net farm income realised as a result of increased red meat production based on supply chain management, development and extension theory.	What are the external factors affecting the increase in net farm income as a result of increased red meat production?	Focus group discussions Key informant interviews Observation Secondary data review

Purposive sampling logic is used to select case studies rather than statistical sampling (Patton, 1987; Yin, 1994). The objective is to select "information-rich" cases, that is those from which a great deal can be learnt about issues central to the research purpose (Patton, 1987). Although the case was pre-selected for the purpose of this research, the project managers had selected the Bei Da Ying farming community for more strategic reasons. This area is fairly typical of pastoral areas in eastern Yunnan with respect to social, political and market issues and constraints (typical case sampling) and was fairly extreme with respect to the severity of the physical constraints to pastoral production (extreme case sampling) (Patton, 1987).

7.3 Research methods

7.3.1 Experiments – Fertiliser trials, pasture and feed monitoring

Bei Da Ying and Lang Mu Mountain were the two sites used most extensively for pasture monitoring providing two indigenous pasture monitoring sites and five improved pasture monitoring sites and farm systems research. Animal performance was monitored at all project sites. Pasture and feed monitoring carried out on demonstration farms and research centres included:

(i) Pasture growth rate – measured monthly by cutting under cages and calculated by difference (Hodgson et al., 1999). At least ten 0.1 m^2 quadrat cuts were made for each demonstration farm and pasture type every month.

(ii) Daily animal intake – calculated by difference in pre- and post-grazing pasture cover assessed visually at each paddock change, less any supplements fed (Hodgson et al., 1999). Daily animal demand was calculated each month; based on liveweight, physiological status, and required performance (Geenty and Rattray, 1987).

(iii) Average pasture cover – assessed visually each month over the whole of each farm (Hodgson et al., 1999).

(iv) Daily supplement feeding – supplements all weighed daily before feeding to livestock.

(v) Phosphorous and potassium fertiliser trials were monitored monthly. The trial designs were developed and implemented prior to the researcher being involved. Initial monitoring involved single 0.1 m^2 quadrat cuts per replication (three replications per treatment). However, this was changed to mowing the central 2.0 m^2 of each replication to 3 cm (Hodgson et al., 1999) to provide yield measurements, supplemented with 100 g fresh weight samples to determine dry matter content and botanical composition.

Monitoring procedures were taught to technicians responsible for project data collection and farm monitoring by the researcher prior to the commencement of monitoring. The researcher regularly monitored procedures used by project technicians and compared measured/assessed results with his own observations. Pasture and animal data presented in the study were collected as part of the AHB/GGERI project; their collection was not necessarily directly by the researcher unless otherwise stated.

Fertiliser trials, system experiments and monitoring provided the basis for the researcher to evaluate alternative practices and technologies as part of the project. These trials and experiments were carried out on the Bei Da Ying demonstration farm, the Bei Da Ying pasture and soil research centre, and on the demonstration farms at Lang Mu Mountain. Also, the researcher could observe the advantages and disadvantages of farmer practices and management during the frequent field visits.

7.3.2 Surveys

7.3.2.1 Goal ranking survey

The method of paired comparison (Bradley, 1976; Harper and Eastman, 1980) was used to develop the ranking of a goal hierarchy for the project farmers as opposed to an array method (e.g., Fairweather and Keating, 1994) and the Likert scale method (e.g., McGregor et al., 1997). The paired comparison method allows the determination of rank ordering of goals along a relative continuum (Harper and Eastman, 1980) with the certainty that each goal has been compared specifically with each of the other goals.

The paired comparison method requires each respondent to be presented with a list of possible pairs of goals within the given set, and that the respondent select the preferred goal in each pair. In their study of US small farmers, Harper and Eastman (1980) used two sets of goals, family goals and farm enterprise goals, to enable a comparison between what the family wanted and what the farm enterprise wanted. Harper and Eastman (1980) designed generic or proxy goals to measure preferences for specific socio-economic goals or concepts: quality of life, preference for income, preference for net worth, preference for consumption, and preference for social status.

In this study, these concepts were adjusted to fit the socio-economic situation of the farmers in the survey. Risk aversity was added because risk is important to all farm businesses, and because of the considerable livelihood risks poor people face (Byerlee et al., 1980; Ellis, 1988; Dillon and Hardaker, 1993). The quality of life concept was changed to livelihood[28] as it was considered a more complete term and is in keeping with modern development theory (e.g., Chambers and Conway, 1992). Aversity to labour or effort is another concept frequently attributed to poor people (Ellis, 1988), so this concept was also added to the list. The goals used in the survey are shown below (Table 7.3, Chinese translation in Appendix 1).

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[28] Livelihood is defined as: the means of gaining a living and the capabilities, assets and activities required for it (Chambers and Conway, 1992).

The two sets of six goals required each respondent to make two sets of 15 goal comparisons. Each respondent took about 30 minutes to complete the survey.

Before surveying farmers, the translated questions were pre-tested for ease of comprehension by a project colleague and then by two farmers from Bei Da Ying Village. Considerable time was also spent explaining the methodology of the paired comparison survey to the interpreter. The researcher supervised the implementation of the survey and recorded respondents' selections.

Table 7.3: The generic socio-economic goal concepts, and the associated family and farm goals assessed in the study survey.

Concept	Family Goals		Farm Goals	
Income Seeking	F1	To maximize cash income	P1	To increase income/profit from farming
Net Worth Seeking	F2	To maximize net worth (material accumulation)	P5	Increase net worth derived from farming
Labour Aversity	F3	To maximize leisure and quality of life	P4	Reduce labour input
Social Status Seeking	F4	To maximize social status and prestige	P3	Increase farm resources (number and quality of resources)
Risk Aversity	F5	To maximise self-sufficiency	P2	Assure stable level of income and output (avoid low profit/high loss years)
Livelihood Improvement and Sustainability	F6	To maximize education of children	P6	Improve quality of life resulting from farm involvement in farming

The list technique used by Harper and Eastman (1980) was not employed in this study because after consulting with project colleagues, the researcher perceived such a list of the 30 required comparisons would seem daunting and confusing to most of the respondents, mainly because of the low literacy level in the study area. Also, in the pre-test, one of the farmers wanted to abandon the paired comparison method and just rank the goals in each set directly, partly to save time and partly because he did not understand the value of the superior rigour the paired comparison method provided. To overcome these two difficulties, cards (100 x 50 mm) with individual goal statements printed on them were made so that the respondent only had two goals to view at any one time.

The survey was carried out in eleven farm family households at Bei Da Ying; nine men and six women were surveyed, n = 15. The small, non-random sample size meant no statistical analysis was carried out.

Survey responses were plotted on a cumulative distribution function to determine the dominance of each goal over the other goals, and thus, goal ranking. This technique has been used widely in risky investment decision analysis to determine the most preferable investment option (Dillon and Hardaker, 1993; Savvides, 1994), and is adapted here to determine the most preferred goals. First-degree dominance is visually obvious — cumulative distribution functions do not cross each other. The determination of second-degree dominance, when functions cross each other, requires the area under the six functions to be calculated (integration). The cumulative distribution function with the smallest area under the function is said to dominate the others in the second degree (Dillon and Hardaker, 1993; Savvides, 1994).

7.3.2.2 Locus of control questionnaire

Two different approaches have been reported in the literature concerning investigations into locus of control (Kaine et al., 1994). The first approach is to provide a list of randomised statements reflecting either internal or external locus of control with respect to the subject of the statement. For each subject, two statements reflecting opposite loci of control are listed. Respondents are required to state their degree of agreement/disagreement with the statements using a Likert scale. The second approach involves presenting a pair of statements, one reflecting internal, and one reflecting external locus of control with respect to the subject of the statement pair. Respondents are required to select the statement from the pair that most closely resembles their beliefs or perceptions. This forced choice approach results in a dichotomous scoring procedure, and was the method selected for this study. It was believed that respondents could too easily agree with both statements, or were unlikely to express even moderate agreement with strongly worded statements concerning locus of control, leading to a high rate of inconsistent responses. As Kaine et al. (1994) highlighted, the strength of the belief is not of critical importance, but rather whether the farmer believes that an element in the operating environment is or is not subject to some degree of control.

The survey was designed specifically for small mixed farming operations in the study area focused on pasture-based sheep and cattle, and cropping enterprises. Farmer perceptions of locus of control were sought across a range of planning elements, both strategic and tactical. The final six-page questionnaire included 25 sets of paired statements covering tactical issues relating to production, such as maintaining sufficient pasture to feed livestock, animal performance targets, crop rotations, animal health, and pest control, and strategic issues such as financial planning, enterprise/livestock mix, and lambing date. The full questionnaire, in both English and Chinese, is in Appendices 3.1–3.2.

In formulating the statement pairs, the researcher attempted to write each statement in such a way that respondents would feel comfortable about agreeing or disagreeing. It was easier to write statements reflecting an internal locus of control linking action and outcomes in a positive manner, than statements reflecting an external locus of control. This problem seemed particularly pertinent in the study area given the high value Chinese people place on "face". In their study, Kaine et al. (1994) attempted to provide a justification or rationalisation supporting the locus of control in each statement. This approach was used as much as possible in this study.

Example question (first statement exhibits internal locus of control):

> *"I generally find that even though climatic conditions change from year to year, I can still make improvements to both my cropping and pastoral systems' performance"*
>
> *"For a farm like mine, it is very difficult to make improvements because the seasonal conditions vary so much between years"*

After translation, pre-testing was carried out with one project technician and two farmers from Bei Da Ying Village. As a result, the initial survey of 24 questions was expanded to 25 questions. One question relating to market information and the role market information played in farm decision-making was identified to contain two elements. For one element the two farmers perceived an internal locus of control while for the other element the two farmers perceived an external locus of control. Therefore, the question was split into two separate questions.

Prior research identified a link between locus of control and farm performance (e.g., Kaine et al., 1994; Tanewski et al., 2000). Economic farm performance measures are unreliable because they are subject to many sources of bias (e.g., memory, although many farmers studied did keep records of farm activities; "face"; not wanting to disclose true financial position to project staff for fear of losing project assistance). Physical performance measures such as liveweight at sale are also unreliable. Lambing percentage was deemed to be the most reliable and easily measured performance indicator — the researcher, AHB technicians and other farmers can readily count lambs born and sold, and ewes mated. Therefore, lambing percentage to sale was used as the indicator of farm performance.

7.3.3 Interviews, observation & participation

Key informants are people who are particularly knowledgeable and whose insights are useful in assisting an observer understand what is happening. Key informants can be especially useful in providing information about events that cannot be observed directly and in explaining those events actually witnessed by the researcher (Patton, 1987). Key informant interviews and farmer focus group discussions were used extensively during the study. These interviews, like the surveys described above, emphasise the respondent. However, observation, which was also used extensively in the research, emphasises the situation (Moris and Copestake, 1993).

These interviews and discussions were sometimes planned and could be quite long (up to three hours — such long periods would usually be combined with a training course), while at other times were spontaneous and of just a few minutes duration. Planned interviews and discussions were based on a checklist of issues. Interviews were usually held in farm family homes, on farms, or at the place of meeting, and involved one or two family members. Focus group discussions were usually held at the Bei Da Ying research centre or demonstration farm, or in a farm family's home at the Sheep Breeding Farm involving 8–20 farmers. Technician discussions typically involved two to five AHB or project technicians, and were held at the research centre, on demonstration farms or in an office. Farmers (three families at Bei Da Ying) and technicians (four AHB and three project) were the main key informants used in the research and the types of information they each provided are described below.

Initially, all interviews and discussions were completed with the assistance of an interpreter. Before commencing the interviews and discussions, topics and questions to be covered were discussed with the interpreter to ensure as complete as possible understanding, and to ensure the acceptability of those topics and questions. As the researcher gained greater language proficiency, informal interviews and discussions could be held without such assistance, however formal interviews and discussions continued through an interpreter.

Living and working on site in Qujing and at the three project sites allowed the researcher almost continuous opportunity to observe the various participants in the red meat supply chain, and also participants in other resource-competing and consumer-competing supply chains. These observations have been drawn upon widely in the study and are stated as such.

Production system key informants were all farmers from Bei Da Ying and the Sheep Breeding Farm, with occasional clarification required from technicians associated with the area. Focus group discussions were held with the 11 farm families from the Sheep Breeding Farm to discuss current production practices, goals and targets, and long and short-term problems and opportunities for them working for the farm and as they perceived in the wider industry. Focus group discussions were also held with the 19 farm families at Bei Da Ying to discuss production practices, current problems encountered in their farming operations, current activities being undertaken, goals and targets, and problems and opportunities in their village for pasture-based farmers and in the wider industry.

Key informants with respect to prices and incomes were farmers from Bei Da Ying, people buying and selling meat in the wet markets (when the researcher was shopping), other farmers met during two years in Qujing in non-project villages and at livestock and wet markets. Farmers and technicians provided information as to the markets and supply chains for agri-products.

Consumer expectations and buying habits were mainly observed in wet markets by the researcher, with friends and technicians providing clarification and explaining observed situations to the researcher. An evaluation of secondary data (see Section

7.3.4) also provided further guidance with respect to the wider China market, particularly to the more developed eastern provinces.

Some technology information was collected by interviewing technicians and farmers, but largely by researcher participation. The researcher, as part of the project, formally evaluated benefits from technologies. Discussions with farmer groups, key informant farmers at Bei Da Ying and the Sheep Breeding Farm and with project technicians working at the Lang Mu Mountain site also provided evaluations of the technologies. Farmers were interviewed, and/or questioned collectively during discussions and training sessions about how appropriate they felt the researcher's suggestions to be for them.

Example question to farmer:

> *"How do you perceive pre- and post-grazing pasture cover targets to be of value to you in your situation?"*

True farmer opinion as to the adoptability characteristics of technology is expressed by adoption or non-adoption, which was readily observed by the researcher, particularly towards the end of the posting. Before the researcher left Qujing, all 19 farm families at Bei Da Ying were interviewed about their plans for their livestock and cropping systems for the coming year, providing a valuable insight into changes in farmer perceptions and expectations over the two-year study period.

Key points and farmers comments were recorded in field notes. The data and ideas gathered from these interviews and discussions were continuously reflected upon and integrated into the researcher's understanding of the situation, and this understanding was regularly checked and verified through detailed discussions with several key informant farmers and technicians. These discussions also provided the means to triangulate the data collected from other sources. Secondary data (described below) was also a useful source for verifying the researcher's understanding.

7.3.4 Archival analysis – Secondary data

Secondary data sources were used widely, initially as a guide to researcher questioning, and later as a source of clarification of responses and observations.

Secondary data also provided the "official" and "international" positions on events and situations in China. Secondary data was used extensively in gaining a more detailed understanding of the wider economic and social environment — the researcher's position as an employee in a relatively remote region of China did not allow for a personal and in-depth study of these aspects. Access to policy and industry level information was limited, and the accuracy of such information provided was often doubted because of uncertainty as to collection methods, because it failed to fit with researcher observations, or because of the difficulty with which it was obtained. The researcher's position as a project employee and a United Nations Volunteer also meant that questioning in areas outside of the project brief was constrained for largely political reasons. These reasons included that such questioning suggested that the focus and scope of the project was misguided.

7.4 Quality of research design

The quality of case study research can be assessed by considering the logic and testability of the findings based upon the evidence collected and reported, together with the methods used to gather the data (Eisenhardt, 1989b). In social science, four logical tests are used to assess research quality (Yin, 1994): construct validity, internal validity, external validity and reliability. Internal validity is not relevant in exploratory case studies (Yin, 1994).

7.4.1 Methodology

Patton (1987) described five dimensions along which fieldwork varies, and those dimensions influence the participant observation methods that should be employed. These dimensions are:

- Role of the observer;
- Portrayal of the observer's role to others;
- Portrayal of the purpose of the observations to others;
- Duration of the observations; and
- Focus of the observations.

In a usual situation, the researcher would select the approach that best fitted the purpose of the study and the type of data to be collected. However, in this study, most of the dimensions were pre-determined by the nature of researcher's position and status.

The role of the researcher (observer) was as a partial observer because the researcher did participate in hands-on farm work and implementing the project, but also maintained an observer side. Full participation or "going native" was probably unnecessary to understand the constraints and opportunities facing farm families at Bei Da Ying. Indeed it is unlikely that the researcher would have been accepted in such a role or could even have physically tolerated complete immersion. Similarly, remaining as an onlooker would not have yielded the insights or understanding the researcher was able to gain. An onlooker would have been unable to build trust with participants and they would never have seen any value in interacting with the researcher, as time is one of the participants' key resources.

The portrayal of the role of the researcher (observer) to others was completely overt as it was not possible to hide the fact that the researcher was not of Chinese descent. This would definitely have impacted upon the validity of the data collected, especially from farm families and AHB technicians. This effect was probably less with respect to the project technicians because of their greater exposure to foreigners and the long periods of time spent with the researcher.

The portrayal of the purpose of the researcher (observer) to others was generally full and explicit as far as farm families were concerned with informed permission gained before interviews, focus groups and surveys. This was to respect participants' time constraints and rights, and to ensure they were comfortable discussing different issues in forums where local officials and technicians were often present. However, the researcher was often less open with technicians and officials to avoid bureaucratic barriers and to safeguard data collection processes and the data collected.

The duration of the observations was over a two-year period. This was probably sufficient for the researcher to gain a detailed appreciation of what is a complex and completely new situation. A shorter period might have been feasible had the researcher's role been solely directed towards completion of this study.

The focus of the observations was broad. The study was broader than the project the researcher was employed in which did create difficulties for the researcher with respect to interviewing and data collection. Hence, "covert" field research was sometimes necessary.

7.4.2 Construct validity

Construct validity is the establishment of correct measures for the concepts being studied (Yin, 1994). Yin described three tactics for increasing construct validity:

- Using multiple data sources to facilitate convergent lines of inquiry during data collection;
- Establish a chain of evidence during data collection; and
- Have the draft case study report reviewed by key informants.

Multiple sources of data were used including interviews with farmers and technicians, focus groups, observations and secondary data. It is possible to follow the initial evidence from the results and literature review to the ultimate research conclusions. Key informants did not review the draft case study report (this was not possible due to language, literacy and location). However, key points were summarised and fed back to interviewees to ensure understanding before each interview concluded. Also, research findings were discussed with key informants (usually project technicians) after a series of interviews to assess construct validity.

Because of the long-term contact between the researcher and research subjects and key informants, a high level of trust was built, ensuring that the construct validity of the research relying on qualitative methods was maintained. This also applies with respect to the friendship forged between the researcher and the interpreter. It is likely that the positive and constructive input contributed by the researcher to the project and project participants assisted in the development of trust and ensured more ready co-operation from respondents than if the researcher had been operating in a purely extractive fashion. However, it may have also been that farmers wanted to appear co-operative and receive more project support, though farmers were aware that the researcher had no control over project funding and allocation or inputs.

Accuracy of pasture and feed monitoring was not always high. However, the researcher was able to introduce changes in monitoring procedures to improve the accuracy of data from 1999 onwards. Regardless of these changes, the researcher sometimes preferred to use personal visual assessments, measurements and calculations. It is possible that these observations and measurements were based upon a "New Zealand model", but it is believed that the long period spent in China would have provided adequate exposure to environmental conditions, ensuring that the researcher's model was based on these local conditions.

7.4.3 External validity

External validity deals with the problem of knowing whether a study's findings are generalisable beyond the immediate case study (Yin, 1994). That is, do the results of the study of small-scale mixed livestock and cropping farm families at Bei Da Ying apply to farm families in other villages or regions? The main tactics for increasing external validity are (Patton, 1987; Yin, 1994):

- Use of multiple cases;
- Describe the case and context to demonstrate the extent of typicality and credibility;
- Obtain observations from different perspectives and participants;
- Use multiple methods to collect data; and
- Use purposive sampling.

Multiple cases were not used for political reasons. The case study describes in detail the context in which the research was undertaken. Different participants within the red meat supply chain were interviewed including farmers, restaurateurs, consumers and technicians (who are essentially outside the supply chain). Interviewing other supply chain participants, such as livestock dealers, would have provided a more balanced set of results. The case study was strategically selected for its typicality.

The extensive use of participant observation, though perhaps not offering a high degree of external validity, was necessary and justified by the constraints placed on the researcher because of the position and location of employment, and the narrow focus of the GGERI/AHB project.

Credible quantitative data was readily available for some aspects of the research (e.g., livestock numbers, farm area, pasture production, farm gate prices and animal performance) because these could be directly observed or measured in an unbiased manner. However, other aspects of the research did not have free or ready access to credible information, and responses could be tempered by the presence of people other than the researcher due to issues of "face" (*mianzi*) and fear of consequences resulting from those responses. For example, some farmers may have adjusted their responses to questions regarding goals and perceptions of technology, to ensure they were aligned with other people present, thereby avoiding any possible retribution. The researcher's position as both a project employee and as a volunteer for the United Nations also meant that it was not possible to freely collect information as might have been feasible in a research posting. However, information with respect to industry co-ordination and opportunities for increased management of the red meat supply chain in Yunnan may still not have been readily available in alternative circumstances.

Employing a range of recognised research methods ensured credible data (either contextual or precise as necessary) could be collected, and allowed for the complexity of the system being studied (Chen, 1997). A mixed methods research design also ensured that the research was carried out in a manner allowing all questions to be answered and responses understood, and provided usable results (Datta, 1997). Although there are trade-offs in the design of the research methodology, detailed understanding has been possible, and results are relatively generalisable.

It could be argued that the validity of these observations is improved by the considerable length of time over which they were made. However, it could be equally argued that researcher objectivity may have been compromised by the long research period. Also, in many cases, key informants, or a subsequent review of secondary data sources and discussions with other development workers with experience in China, often later reinforced conclusions drawn on the basis of observation. However, development workers may be subject to effects similar to those acting on the researcher.

7.4.4 Reliability

The objective of reliability is to be sure that if another investigator followed exactly the same procedures described and conducted the same case study that identical conclusions would be reached. Reliability is about minimising errors and biases in a case study (Yin, 1994). Yin (1994) suggested that a case study protocol be used to guide the research process and detailed case study database be constructed to increase the reliability of research.

The case study design was not well formulated prior to fieldwork commencing, and continued to evolve as the research progressed. This was partly due to the exploratory nature of the study, but also reflects the level of appreciation and understanding the researcher had of qualitative research methods at the time of undertaking the fieldwork. Thus, the methodology could have been structured in a more rigorous manner and recorded more regularly to better facilitate repeatability and reliability. Similarly, a case study database was not constructed. This in itself is probably not of great concern, but the manner in which the vast amount of data was collected, recorded and collated was poorly structured. These two factors not only reduce the reliability of the research findings, but also made the write-up phase more challenging for the researcher than perhaps it should have been. However, sub-objectives (see Table 7.2) under each of the four research objectives were structured and did provide a useful guide for determining data requirements for the research, and also in the researcher's view, the best sources for that data. These questions also provided a useful framework for presenting the research results, even though the sequence was altered for presentation of the results.

8 Results

8.1 Yunnan Province's red meat supply chain

8.1.1 Current farm production systems

A typical mixed cropping and livestock farm includes 100 mu of pastoral land. For the 19 farm families at Bei Da Ying this area ranged from about 35 to 180 mu. The pastures are generally unimproved indigenous species of low palatability and low nutritive value (e.g., bladey grass *Imperata cylindrica*) growing less than 3000 kg DM/ha/year[29] (Figure 8.1). Most farms had some improved pasture areas, although these have significantly deteriorated to contain a large number of broadleaf weeds and indigenous grass species. The average area of farms under improved pastures is between 30 and 40%. These areas produce from little more than the native pastures up to about 6000 kg DM/ha/year. Average pasture growth across all pasture types on farms is between 3600 and 4100 kg DM/ha/year. Indigenous pasture yield is the average of two sites, and the improved pasture yield mentioned above is the average of five sites at Bei Da Ying measured monthly between May 1998 and May 2000.

The average farm carries 22 ewes (plus one or two rams) lambing at 80% survival to sale (the sheep breed is known locally as Cormo, and resembles New Zealand's Corriedales). Lambing is in August and September (late Summer/early Autumn) and the main shearing time is April (late Spring). Ewe liveweight throughout the year is generally around 40 kg (ranging from 35 to 55 kg at mating in April). Lambs weigh about 33 kg at one year and are sold between September and November at 35–38 kg liveweight. Seven ewe hoggets for replacement are also kept (i.e., a 33% replacement rate). A typical 100 mu farm also carries four local Yellow Cattle (mature liveweight for females is 250–300 kg and can be up to 350 kg for males) for fattening and cultivation labour. This equates to a stocking rate of approximately 4

[29] DM = dry matter, a unit of herbage mass.

su/ha[30]. Buffalo and horses may also graze pasture. A typical animal feed demand profile versus feed supply is shown below (Figure 8.2).

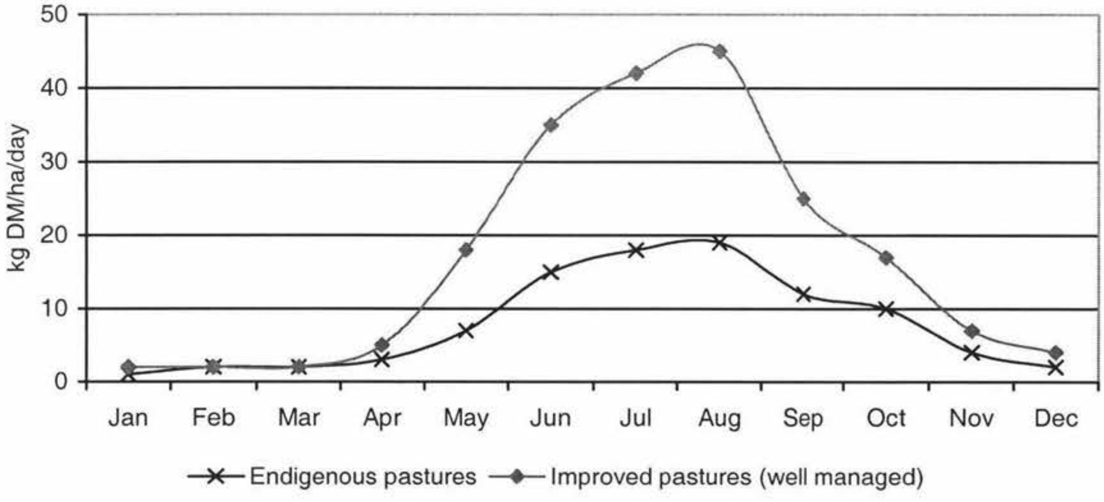


Figure 8.1: Pasture growth rate of indigenous pastures and improved pastures (well managed) in Qujing Prefecture (indigenous pasture = average of 2 sites at Bei Da Ying and the improved pasture = average of 5 sites at Bei Da Ying, from May 1998 to May 2000, measured using monthly pasture cuts).

Average pasture utilisation on a typical mixed farm in the study area is estimated at 60% across the year (based on pasture monitoring, livestock demand calculations and livestock consumption measurements carried out at each project site from May 1998 to May 2000) (Figure 8.3). This rate of utilisation is comparable to many farms in New Zealand and is high compared to most monsoon-based pastoral systems. Thus, not only is pasture production (approximately 3600–4100 kg DM/ha/year) relatively low compared to potential pasture production (to be discussed in Section 8.3), but the actual amount of pasture consumed by livestock (net herbage production) calculated to be approximately 2450 kg DM/ha/year, is also very low.

[30] su/ha = stock units per hectare, a measure of stocking rate used widely in New Zealand. 1 su = 550 kg DM/year = 1 55 kg ewe raising 1.1 lambs to weaning.

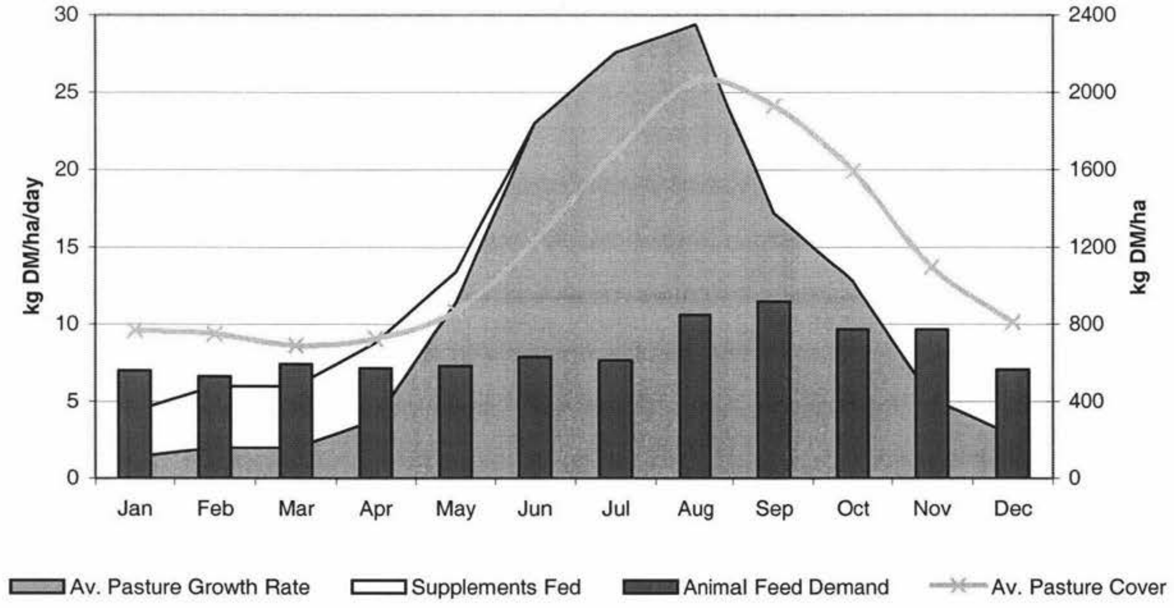


Figure 8.2: Typical feed supply and demand balance for pastoral farms in the study area. Data sourced from three farms monitored at Bei Da Ying from May 1998 to May 2000. Full feed budget in Appendix 2.1.

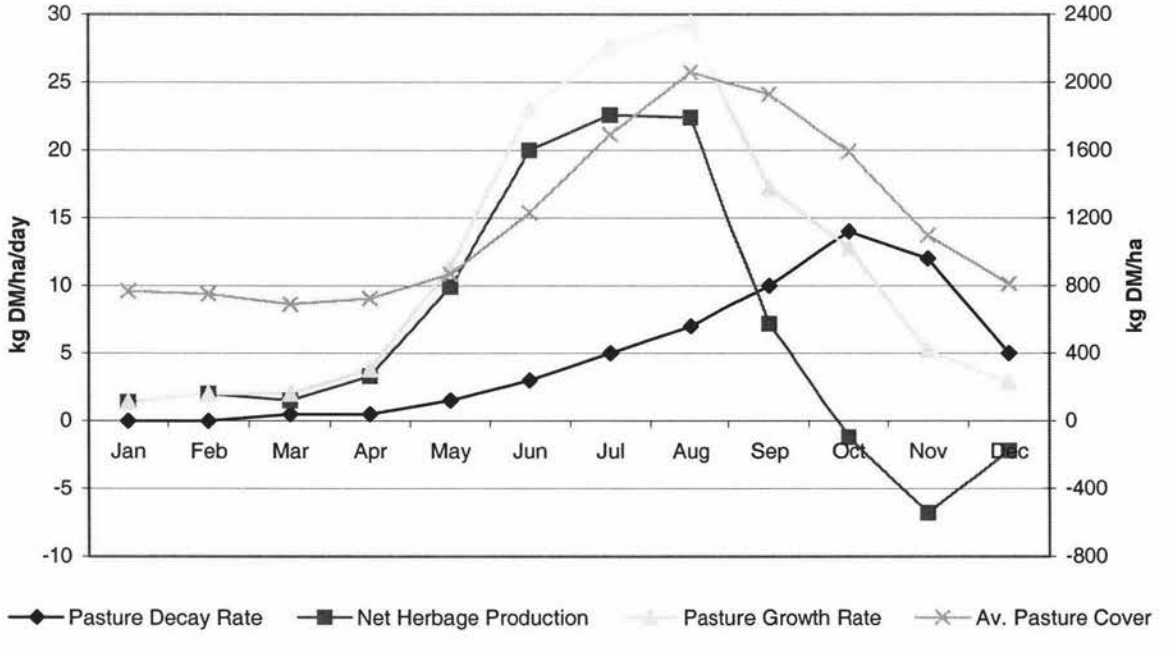
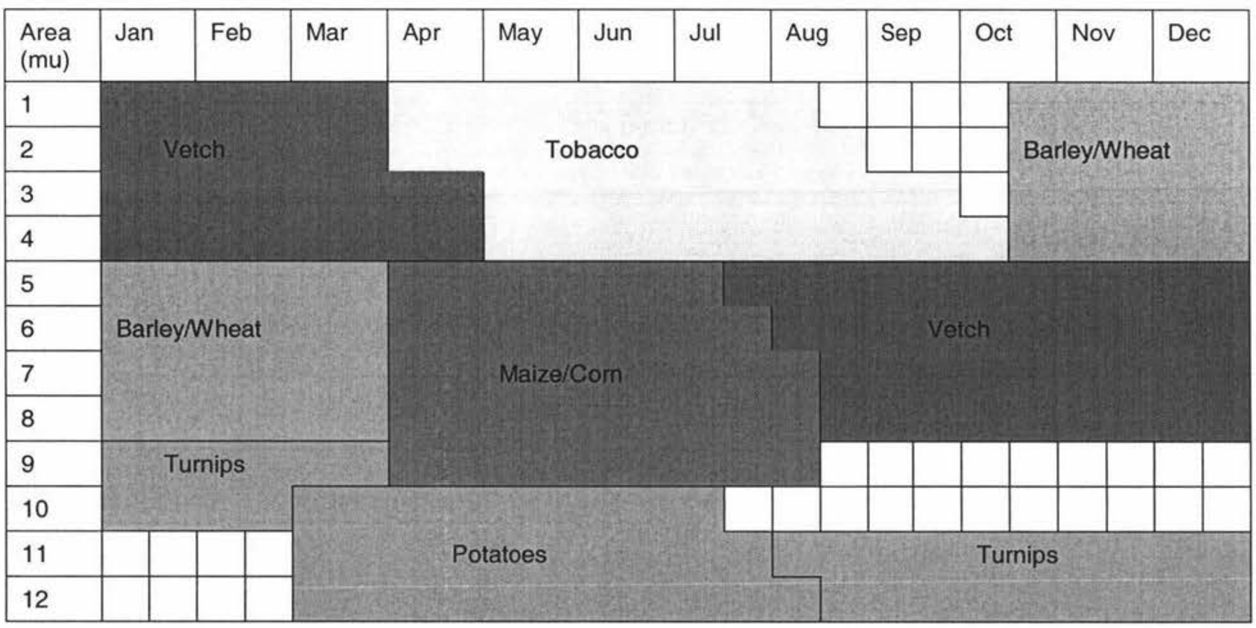


Figure 8.3: Measured pasture growth rate, measured average pasture cover, calculated decay rate and calculated net herbage production for a typical farm in the study area. Data sourced from monitoring of three farms at Bei Da Ying from May 1998 to May 2000.

The average mixed farmer in the study area has 12 mu of arable land. A typical land use schedule for the study area is shown below (Table 8.1). Vetch, barley, wheat stubble, turnips and much of the maize is used to feed livestock over the dry and cold winter period, and continues to be fed into the dry, warm spring when pasture growth rates are too low to meet animal demand. Pasture quality during the winter/spring period is also at the lowest for the year.

Tobacco is almost always grown after vetch (*Vicia sativa*) and on the best quality arable land because farmers recognise the benefits vetch provides to the soil such as boosting nitrogen and organic matter content along with improved soil structure. Most farmers do not follow a strict crop rotation — some cropping decisions are based on prevailing market conditions, but the highest value crops such as tobacco are never grown after high nutrient demanding crops such as potatoes and maize without either a winter fallow or vetch. A large amount of livestock manure is applied to each crop together with inorganic fertilisers such as phosphorous-based fertilisers and urea. Vetch is the only crop for which most farmers buy seed rather than collect their own, because seed collection is difficult and time consuming.

Table 8.1: Typical land use schedule for mixed farmers in the study area. A Bei Da Ying farmer drew the original diagram in March 2000.



Note: The exact crop rotation is not illustrated by this land use schedule, as there is no fixed rotation used in the study area. Rather, it provides a "snap-shot" view of the crops grown and the area grown at any one time on the farm. Blank squares represent fallowed cropland.

8.1.2 Farmer goals

The small survey (n = 15) of farmer goals provided a clear understanding of the goals of small mixed cropping and pastoral livestock farmers in the study area. Livelihood improvement was the generic goal most frequently ranked highest within both the farm goals and the family goals using the paired goal ranking method (Table 8.2).

In focus group discussions with project and AHB technicians about farmer goals, higher income was consistently rated as the goal central to farmers. Also, technicians often cited reduced labour input as a key goal for farmers involved in the project. At the same time some of these technicians state that:

> *"farmers will never be able to significantly raise their income from farming (both livestock and cropping) because they are lazy, stupid, think in traditional ways and are not open, to and reject, new ideas."*
>
> AHB Technician

Table 8.2: Ranking of Family and Farm Goals by farmers from the smallholder project site at Bei Da Ying (n = 15, includes both male and female household members).

Rank	Family Goals		Farm Goals	
1	F6	Livelihood - To maximize education of children	P6	Livelihood - Improve quality of life resulting farm involvement in farming
2	F4	Social Status - To maximize social status + prestige	P3	Social Status - Increase farm resources (number and quality of resources)
3	F5	Risk – To maximize self-sufficiency	P5	Net Worth - Increase net worth derived from farming
4	F3	Labour - To maximize quality of life + leisure	P2	Risk - Assure stable level of income and output (avoid low profit/high loss years)
5	F2	Net Worth - To maximize net worth (material item accumulation)	P4	Labour - Reduce labour input
6	F1	Income - To maximize cash income	P1	Income - To increase income/profit from farming

This survey clearly shows that generating maximum income is actually the least important goal of those goals tested, and reducing labour input is also considered of low importance (Figure 8.4 and Figure 8.5).

With respect to family goals (Figure 8.4), improved livelihood (F6) dominates all other generic goals (first degree domination). In this survey, providing the best possible education for children was used as the proxy (example) improved livelihood goal — offering improved livelihood opportunities to their children was clearly the most important goal. In line with this highest ranking, F6 is negatively correlated with all other family goals except for F4 (social status).

In focus group discussions, farmers tended to focus on production objectives such as crop yields (pasture yields were not mentioned), number of animals carried, number of animals sold and liveweight at time of sale.

One group of farmers on the state-owned Sheep Breeding Farm at Xun Dian had well defined production and financial goals:

> *"To graze 90 breeding ewes*
>
> *To achieve 90% lambing to sale*
>
> *To produce 4 kg wool per breeding ewe*
>
> *To generate a gross farm income of 20,000 RMB"*
>
> Farmer focus group discussion

These goals are, however, based around the stud farm's incentive schemes. Hence, all farmers had similar objectives, although there was a considerable range in farmer confidence in the attainability of these objectives (e.g., gross farm income for this group of farmers ranged from 9,000 RMB to 23,000 RMB in 1999).

The farm goal (Figure 8.5) ranked highest most frequently is "to improve the quality of life resulting from involvement in farming" (P5). This goal dominates (second degree dominance) all other goals, however, both social status and net worth had similar ranking cumulative distributions. Risk (assuring stable income, i.e., avoiding low profits and losses) was either considered to be of little importance, or of quite high importance. Risk and income goals (P2 and P1) are closely related (r^2 = 0.5193).

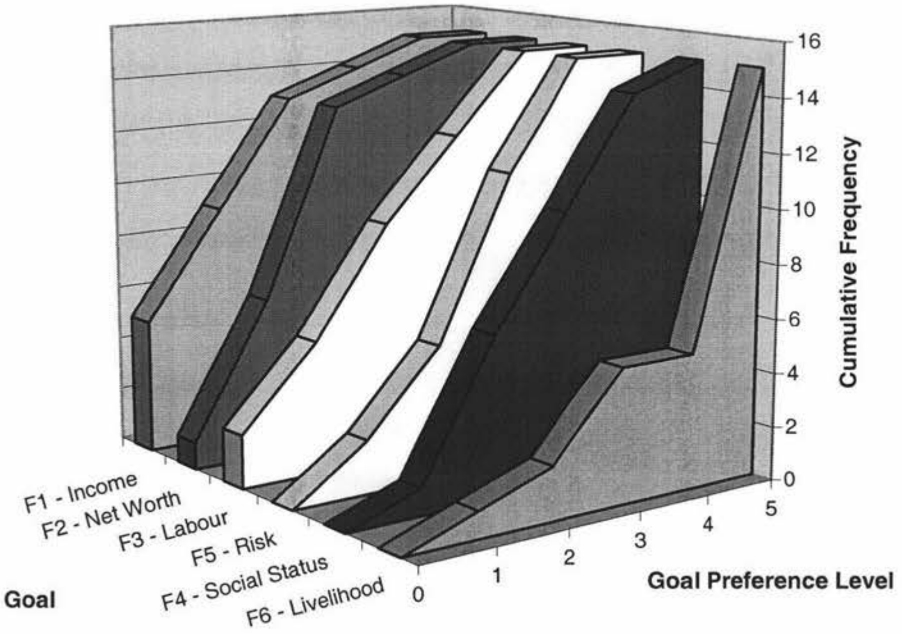


Figure 8.4: Family Goal preference ranking cumulative distribution (n = 15). Goal Preference Level 0 = lowest ranking, 5 = highest ranking.

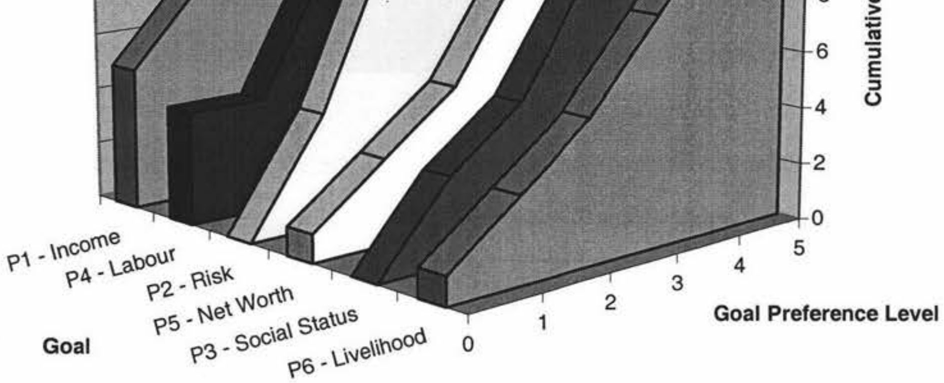


Figure 8.5: Farm Goal preference ranking cumulative distribution (n = 15). Goal Preference Level 0 = lowest, 5 = highest.

All farmers surveyed in the study area recognised that although maximising income was not their most important goal, increasing income was essential for the attainment of many of the other goals. For example, when questioned approximately 6 months before the goal survey on what increased income would be spent on, farmers would often point to their children and say "high education" and then point around their rooms saying they wanted new furniture or appliances. Very few responded that they would invest increased income in farm development. When prompted on the importance of investing in farm development for the family, farmers stated that they would need to see increased prices before investing in new pastures, fertiliser and subdivision (in farmer interviews and focus groups in 1998 and early 1999).

8.1.3 Agricultural input and output markets and price patterns

8.1.3.1 The wool market

Farmers in the study area only sold wool immediately after shearing in April. Wool is sold unclassed, and generally to travelling wool traders, although some farmers have been able to sell directly to wool scourers and blanket manufacturers in the local county. Average farm gate prices received in 1998 and 1999 by surveyed farmers for greasy wool were 7–8 RMB/kg greasy. This compares with 15 RMB/kg greasy received by one farmer in 1989. Some farmers retained some wool for further processing to make into bedding and clothing for the family, however the proportion kept for this purpose is low.

8.1.3.2 The sheep meat market

Store sheep and goats are traded at local livestock markets using a bargaining system. However, most store stock is sold away from the market because it is too difficult to control own livestock effectively among other vendors' animals. Finished stock is mainly sold by farmers directly to travelling livestock traders who buy locally and then on-sell either live or slaughtered livestock in larger urban centres to local restaurants or to licensed meat retailers (licensed meat retailers mainly sell pork and cooked meats such as smoked duck and ham).

Sheep meat is only eaten in Southwest China in May following a festival in the region, and again in autumn. These are seasons when the weather is not too hot – sheep meat is considered to be a "hot" meat (higher energy content, see Table 8.3), compared with meats such as chicken and pork. Consumption levels are generally low because sheep meat is a non-traditional meat in the region, and the price is relatively high compared to white meats (Table 8.3). Sheep meat is not eaten in the other seasons because the animals are thought to be in poor body condition (especially winter and early spring) so therefore reducing the quality and taste of the meat. The summer temperatures are considered too hot for "hot" meats. These factors all influence the price pattern, together with grass/feed supply (Figure 8.6).

Table 8.3: Retail meat prices in Qujing City, the capital of the prefecture containing the study area, and energy content of these meats. Sources: Prices collected by asking retailer stallholders and shoppers in city wet-markets 1998–2000; energy content adapted from Diem (1981, cited in van Gelder et al., 1998).

Meat	Retail Price (RMB/kg)	Energy Content (MJ/100 g)
Pork	8–10	0.70
Chicken	12–13	0.82
Goat	13–14	0.69
Beef	13–14	0.77
Sheep meat	13–14	1.24

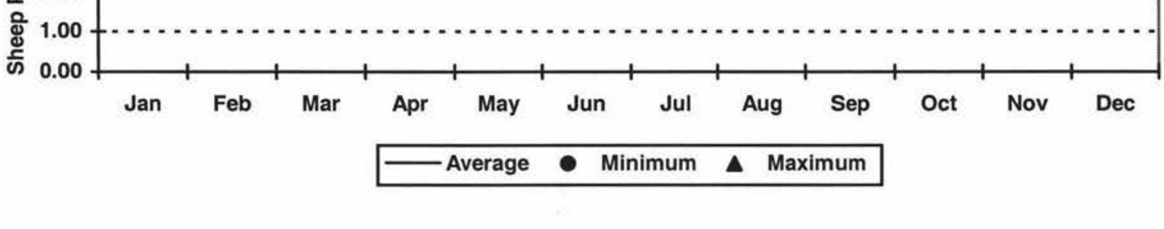


Figure 8.6: Farm gate sheep meat prices (RMB/kg liveweight). Price data provided by farmers at Bei Da Ying in March 2000 during a focus group discussion based on prices received 1998–1999 and expected for 2000.

8.1.3.3 The beef market

The beef price in the study area is most closely related to pasture and feed supplies — pasture surpluses do not start to build up until August or even September in most parts of the study area. The beef price is also related to a demand for beef that is higher when beef cattle are perceived to be in the best condition, at the end of summer and autumn (Figure 8.7).

Most beef cattle are sold on the hoof, by liveweight, in the local livestock markets operating on set days particular to each village (many small villages are named after the lunar calendar day on which the market is held). Cattle, especially herds of cattle (ranging in size from 3 beasts upwards), are also sold privately away from the market.

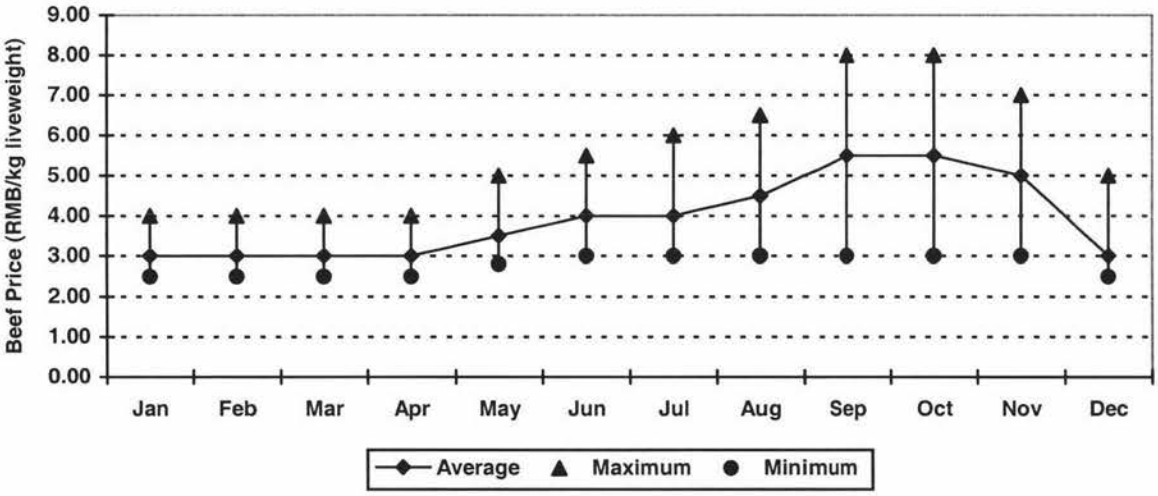


Figure 8.7: Farm gate beef prices (RMB/kg liveweight). Price data provided by farmers at Bei Da Ying in March 2000 during a focus group discussion based on prices received 1998–1999 and expected for 2000.

8.1.3.4 The crop and grain market

The crop and grain markets in the study area have undergone major adjustments between 1998 and 2000. Prices for food and dryland cereal crops have fallen significantly. Many prices have fallen to50 % of recent years' levels. Potatoes have fallen to 25% of the price in 1997/98, though this still has the highest gross margin of the main food crops grown (Table 8.4).

Table 8.4: Expected gross margins for the main food crops grown in Yunnan high plateau regions based upon 1997/98 and 1999/2000 prices. Price, yield and cost data collected during farmer focus discussion groups and farmer interviews.

Crop	Yield (kg/mu)	1999/2000 Price (RMB/kg)	Variable Costs (RMB/mu)	1999/2000 Gross Margin (RMB/mu)	1997/1998 Price (RMB/kg)	1997/1998 Gross Margin (RMB/mu)
Potato	1000	0.30	50	250	1.20	1150
Corn	240	0.75	110	70	1.30	202
Barley	150	0.50	23	52	0.75	90
Wheat	300	0.60	23	157	1.00	277

According to Bei Da Ying farmers interviewed, these price reductions are due to three factors:

(i) Tobacco quota has been cut by 50% in many parts of Yunnan and this is resulting in a large increase in cereal and potato supply as the area previously planted in tobacco is converted to food crops (corn/maize, potato, barley and wheat);

(ii) Agricultural product subsidies have largely been removed; and

(iii) There are large quantities of grain being imported from North America.

Technicians confirmed that the tobacco quota has been slashed by 50%, which will have significant implications for Qujing Prefecture's tax revenue. Revenue from tobacco is also highly variable. Farmers at Bei Da Ying stated that revenue per mu could be either very high (1000 RMB/mu) or almost nothing, depending on the quality of the leaves grown and the demand from tobacco companies. High returns could be expected about a quarter of the time and very low returns the other three quarters of the time. However, some families with better land or more *guanxi* (personal relationships) with tobacco company staff were able to earn high returns every year.

Technicians also confirmed that subsidies paid to farmers for agri-products have also nearly been eliminated. Yunnan is a net grain importer and has been for a long time. However, provincial grain-bag policies (Section 2.1.8) as specified by central government seem to have further increased the amount of grain imported.

These changes in the agricultural market and environment have led to increased interest in the livestock industry, and especially in pasture fed and grazing animals. There is also an increased interest in growing stock food crops to better match feed demand and supply.

8.1.4 Current farmer income

At Bei Da Ying, many farmers raise three pigs a year, slaughtering either one or two for family consumption and selling the remaining one or two in the local Bei Da Ying village market or in the larger urban centres of He Kou Township or Xun Dian County. Also, several sheep are sometimes slaughtered for personal consumption, but this not the preferred meat of farmers. Farmers tend to prefer pork because it is cheaper, traditional, can be readily stored by smoking compared with a large cattle beast, and because it contains a higher fat content providing the energy necessary for physical work.

Average gross farm income for a typical 100 mu farm family is 8,554 RMB/year for a year with high returns for tobacco, and only 4,954 RMB in years with low tobacco returns (Table 8.5). Average operating costs are 2,732 RMB. Expected operating margin is 3,122 RMB per household per annum. The value of saleable produce consumed by the family (two pigs and 2,500 kg potatoes) is 1,710 RMB. The grazing land rental cost 45 RMB/mu for 10 years, paid at the beginning of the lease contract in 1997. Gross income attributable to the pastoral enterprises is 4,375 RMB with operating expenses of 1006 RMB (supplementary feed production and animal health costs) leaving an operating margin of 3,369 RMB (34 RMB/mu pasture or 30 RMB/mu pasture plus supporting cropland).

Fence development and maintenance expenses, and fertiliser applied to pastoral areas have not been included because these costs are typically very low and occur only very infrequently.

Table 8.5: Typical annual income statement for small mixed farmers (100 mu) in the study area. Data collected and collated over study period from farmer focus discussion groups and key informant interviews. LWT = liveweight.

Farm Revenue							
Livestock Sales							
	12	lambs	34	kg LWT @	5.50	RMB/kg	2,244
	3	ewes	35	kg LWT @	4.50	RMB/kg	473
	2	cattle	250	kg LWT @	5.50	RMB/kg	2,750
	1	pig	120	kg LWT @	4.00	RMB/kg	480
Less Livestock Purchases							
	1	ram/2 yrs	400	RMB/head every 2 years			200
	2	cattle	150	kg LWT @	6.00	RMB/kg	1,800
	3	pigs	10	kg LWT @	15.00	RMB/kg	450
Wool	22	ewes	5.5	kg/ewe	7.50	RMB/kg	908
Tobacco	4	mu	100	RMB/mu to	1000	RMB/mu	4,000
Potatoes	500	kg			0.30	RMB/kg	150
Gross Farm Income							8,554
Farm Operating Expenses							
Sheep Health	22	ewes	5	RMB/ewe			110
Cattle Health	4	cattle	5	RMB/head			20
Pig Health	3	pigs	10	RMB/pig			30
Tobacco	4	mu	350	RMB/mu			1,400
Turnips	2	mu	60	RMB/mu			120
Vetch	4	mu	40	RMB/mu			160
Potatoes	3	mu	50	RMB/mu			150
Barley	2	mu	23	RMB/mu			46
Wheat	2	mu	23	RMB/mu			46
Maize	5	mu	110	RMB/mu			550
Salt							100
Total Farm Operating Expenses							2,732
Operating Margin (with high tobacco revenue)					25% of years		5,822
Operating Margin (with low tobacco revenue)					75% of years		2,222
Average Operating Margin			**Over all years**				**3,122**
Plus personal consumption of pork and potatoes							1,710
TOTAL AVERAGE OPERATING MARGIN							**4,832**

8.1.5 Livestock processing and distribution

In 1996, there were 121 beef slaughtering and processing plants throughout China (Lin and Jarratt, 1998). The researcher is not aware of any beef plants operating in Yunnan Province although there are several plants that have operated in the past but have ceased operation. No sheep/goat processing plants are known by the researcher to exist in Yunnan Province. Pig abattoirs are found in most main urban centres and process a high proportion of pigs raised and slaughtered. Poultry processing plants also exist in Yunnan. As well as large slaughtering plants, individuals may also apply for a household slaughtering license, provided the facilities meet hygiene and health regulations. Such operations are usually family run, but may employ several workers during busy periods. Many private slaughterhouses are owned by Muslim (*Huizu* minority) *A-hong* (a man trained in the practice of slaughtering cattle, sheep and goats). Individual farmers can slaughter their own livestock, but do not like to kill their own cattle because of the long service these cattle have often provided in cultivating cropping land. Further to this, most farmers prefer to sell red meat livestock, especially cattle, to dealers on the hoof, even though they may be forgoing considerable profit. Thus, the dominant pathways within the beef supply chain pass through a dealer to a restaurant either directly or via an *A-hong*/private slaughterhouse (Figure 8.8). The supply chain for goats and sheep is similar, the only difference being that sometimes private households may purchase a goat or sheep directly from a farmer and slaughter it for their own consumption. However, the pork supply chain is quite different. Most pigs are sold directly by farmers to pig slaughtering and processing plants. The resulting pork is sold almost entirely via the wholesale market either to butchers with meat retail licences in wet markets, or to restaurants. Animal Husbandry Bureau staff, consumers and observation suggested that approximately 60% of fresh pork consumption occurred within the family home, while the remaining 40% of fresh pork was consumed in restaurants. A large proportion of pork is also further processed into ham, which is sold to private individuals in wet markets and specialty shops, to restaurants, and exported domestically and internationally.

A large number of beef cattle also appeared to be slaughtered on the street in front of restaurants (particularly those owned by *Huizu*) as and when required. Restaurant slaughtering eliminates the difficulties associated with hygienically transporting a large quantity of meat and offal into town from a rural village. Similarly, goats and, to a lesser extent, sheep (due to the relatively small number of sheep eaten) were also slaughtered at the back of restaurants (at the back because unlike a cattle beast they can be walked through the building). However, a number of goats and sheep arrive at restaurants on the back of bicycles already in dressed carcass form.

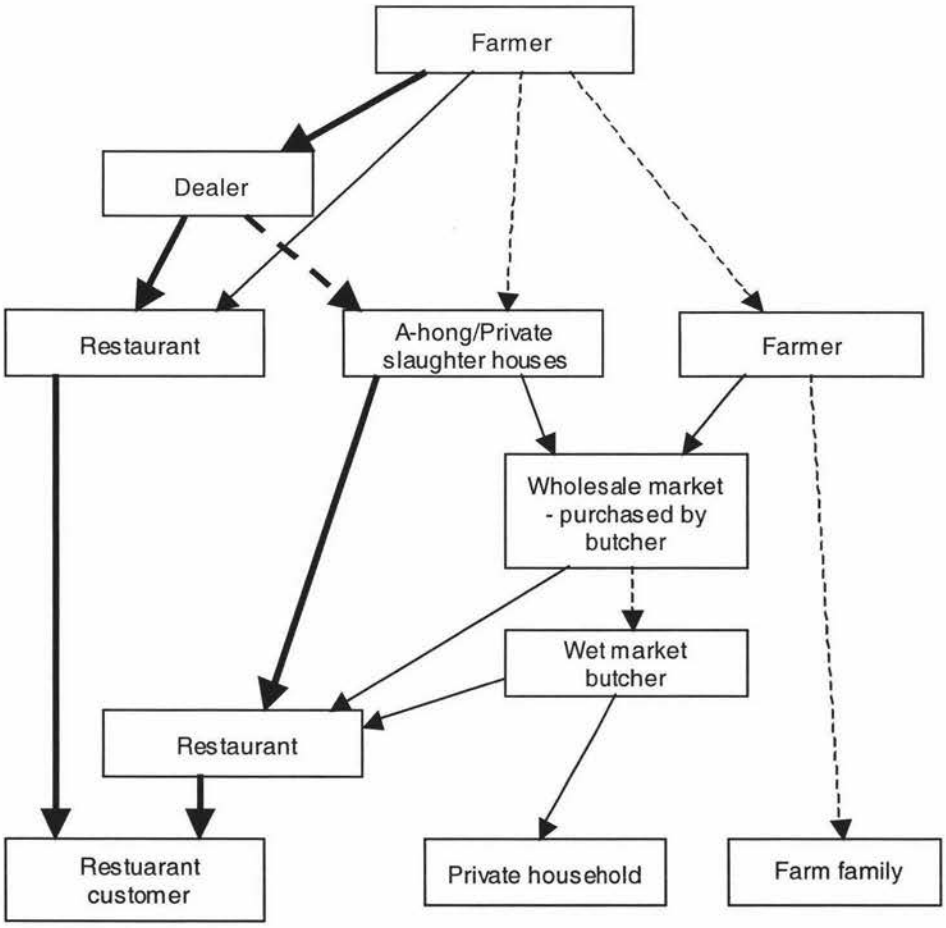


Figure 8.8: Beef supply chain from farmer to consumer in the study area, Qujing Prefecture. Dashed lines show where no transaction has taken place. Heavy lines show the dominant path within the supply chain.

8.1.6 Consumer expectations with respect to red meat

As mentioned above regarding the consumption of sheep and goat meat, beef is also eaten mainly in the winter or cooler times of the year. However, more people tend to be eating out in the evening at barbeque restaurants where red meat is typically ordered. Consumers are also purchasing red meat for cooking at home, but usually only small quantities of less than 1 kg.

Before purchasing the meat, consumers carefully inspect the meat to ensure it is clean, fresh[31], that the colour is bright, that the meat is not sticky and that the meat's odour is not too strong. Consumers prefer to be able to identify the cuts of meat that are on offer. The amount of fat did not appear to be very important to consumers, but the meat typically must have at least 7 mm of fat to be considered prime meat.

Dried beef (*niu gan ba*) is also available and eaten both in restaurants and in the home. Most consumers will only purchase unpackaged dried beef from a Muslim butcher in wet markets (Muslims are considered to produce very good dried beef — butchers of other nationalities would probably find it difficult to sell *niu gan ba* they had dried themselves) for cooking at home, but small packets of factory-produced dried beef are now very commonly sold at bus/train stations, and in stores and in supermarkets as a snack.

8.2 Pastoral livestock system production problems

The production system problems listed below are not ranked in any order of priority. These problems have mainly been identified by the researcher during the two-year position of employment, and in some cases have been identified by staff of other pastoral development projects in Southwest China.

8.2.1 Quality of livestock

The quality of the livestock owned by most of the farmers in the study area was not very high. Many farmers stated that their animals were not high quality and that this was limiting their performance and profitability. Many sheep owned by project farmers were less than 35 kg liveweight and in poor condition; and one two-year old breeding ram in use observed by the researcher also weighed only 35 kg. Small farmers stated that they were not able to afford the cost of offspring bred from imported livestock owned by state breeding farms. During the research period, the researcher did not see these state farms actively seeking to sell or distribute improved livestock around the province even though one of their planned purposes

[31] To Chinese consumers fresh means very recently slaughtered, and similarly for vegetables means cut that morning and carried to the market. For meat, the animal's internal organs are often hung on display to prove the freshness of the meat.

was to supply genetically superior animals to improve the quality of livestock being raised by farmers.

The causes of the poor quality and appearance of many of the animals are most likely:

(i) Low and regionalised livestock populations (especially sheep and goat), so that there is very little transfer of livestock between districts or even breeding farmers, leading to a decreasing gene pool and high levels of in-breeding, lowering their genetic potential. The researcher observed that cattle were traded over a wider area than sheep and goats (sold mainly for slaughter), even between provinces, so that the cattle gene pool in most regions receives regular injections of new genetics from other regions.

(ii) Environmental and management effects, especially underfeeding, so that livestock are not able to express their genetic potential.

(iii) Animal health problems – internal parasites in sheep can be a serious problem. Several farmers at Bei Da Ying lost their entire flocks due to a particular parasite (parasite unknown or sited by researcher). Vaccination is supposedly available to protect against this and other internal/external parasites.

8.2.2 Lack of shelter

Many of the pastoral areas in the study area are very windy. Bei Da Ying is very exposed to strong winds from all directions, but particularly the west. These winds dried the soil, and were very cold in winter. Very few trees were planted or growing in the area — deforestation was, and continues to be, a serious problem in the village, as it is in many other regions of Southwest China. Thus, there was very little shelter for grazing livestock. The researcher believes that this lack of shelter was having a negative impact on animal performance and increasing their metabolisable energy demand because of the need to replace lost body heat. Pasture production was also likely to have been affected at the beginning and end of the main growing season when soil moisture status has the greatest effect on pasture growth rate.

8.2.3 Low cattle numbers

Most farmers could not afford to own many cattle and often did not have the facilities to house a greater number of cattle. The researcher considered that the current sheep:cattle ratio on most farms (between 80:20 and 70:30), was too high and cattle numbers were too low, to enable adequate control of pastures over the summer period. Poor pasture control in summer was one of the critical factors responsible for the rapid deterioration of sown pastures in the study area, both before and during the project. Poor pasture control was observed to lead to increased selective grazing, increased weed invasion, shading and increased grazing pressure on higher quality pasture plants, resulting in reduced survival of productive/sown species and lower pasture growth rates.

Without cattle grazing pressure, pastures became rank towards the end of summer and in autumn, with over-grazed patches in between the rank clumps. This rank pasture eventually lay flat on the ground due to the combined actions of wind, rain and frost, smothering the pasture below it. Decay occurred through autumn, but by January, temperatures were too low to allow decay to continue (the ground was often frozen), so the mat of dead pasture material remained on the ground well into spring, when it appeared largely to be blown away by the wind rather than broken down and returned to the soil.

8.2.4 Lambing date

Most farmers in the study area currently lamb in early autumn. This means that feed demand is not well balanced with pasture growth, but rather with pasture cover. This factor, combined with the low number of cattle on most farms, means that large pasture surpluses readily build up, and this pasture surplus rapidly declines in quality, having an adverse impact on future pasture production. Lambing in early autumn when pasture growth rate is declining means that ewes must lactate on long, poor quality feed. Dead and decaying material was often as high as 40% of the herbage mass in September and October[32]. Lamb growth rates are low (average 60-70 g/day from birth to sale at 1 year old), but enforced weaning does not occur on many farms

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[32] Unpublished data collected during the research period at Bei Da Ying.

because farmers perceive that higher growth rates will be achieved by leaving the lambs with their mothers. Further, there are difficulties in managing separate flocks without subdivision and separate housing. This means that lactation must continue through the winter while the ewes and lambs are fed supplements (50–60% of the diet at that time). Low winter lamb growth rates result in more metabolisable energy, and a greater proportion of total consumed metabolisable energy being directed into maintenance (ME_m) rather than growth or other productive purposes (ME_g), thus reducing feed conversion efficiency and carrying capacity.

8.2.5 Low fertiliser inputs

Soil fertility is recognised by farmers as being a key constraint to producing higher pasture yield and increasing the quality of pasture grown. However, there has been very little fertiliser applied to pasture in the area at any stage. This conflicts strongly with farmer practice with respect to crops where very high levels of fertiliser and manure are used. Farmers commonly used more than 120 kg P/ha and 550 kg N/ha from chemical fertilisers alone in the production of crops such as potatoes, corn/maize and tobacco[33]. Most farmers tend to believe that the more manure (and fertiliser) applied to a crop, the higher the yield and quality will be. However, since pasture is not generally considered to be a crop, even by pastoral farmers, this same practice is not employed on pasture.

8.2.6 Nutrient transfers

The lack of water in paddocks, the lack of effective subdivision, and the lack of livestock security mean that livestock only graze pasture for short periods each day and are housed off the pasture at night. Winter grazing time is 8 hours and in summer grazing time is 10–12 hours. The short grazing period and housing off means that large amounts of nutrients are lost from the pastoral sub-system via livestock transferring dung and urine to livestock houses. It is estimated that such

[33] In 1997/1998, China consumed 22.7 million tonnes of nitrogen, 2.5 million tonnes phosphorous and 2.5 million tonnes of potassium (International Fertiliser Association, 2001). These values do not include manure inputs to cropping land, much of which has been transferred from pastoral areas. This amount of nitrogen fertiliser represents 28% of global nitrogen consumption in 1997/98 on approximately 7% of the world's cropping land to feed approximately one fifth of the world's population and illustrates some significant imbalances. Phosphorous fertiliser use in China is also much higher than in any other region.

short grazing periods would result in the loss of 50% of phosphorous eaten, 40% of nitrogen eaten, and 75% of potassium eaten from the pasture sub-system (Gregg pers. comm., 1999).

This manure is collected and applied to cropping land. Much of the crops grown are for animal consumption, but because these crops are all fed to the livestock within the house area at night, the nutrients in dung and urine sourced from these supplements never return to the pasture. Nutrients in crop residues fed to livestock have the same fate. The belief that pasture is an exclusive land use and that pasture cannot be cultivated for the production of crops ensures that there is never any recycling of nutrients back to pasture land, further compounding the problem. At a stocking rate of 4 su/ha, which is typical for the study area, estimated annual losses of nutrients as a result of housing livestock off the pasture are considerable: 33 kg N/ha, 35 kg K/ha, and 12.4 kg P/ha[34]. Thus, the pasture sub-system is subsidising the cropping sub-system to ensure that high crop yields are achieved relatively cheaply.

8.2.7 Under-grazing, over-grazing and selective-grazing — the combined effects

The winter and spring period is dry and cold, and pasture supply is low. It is during this period that pastures are most often over-grazed, and this time is also when the sward is least able to cope with the stress of over-grazing because conditions for growth are very unfavourable. The continuous severe grazing common on many farms slows pasture recovery in spring and early summer, and reduces future pasture productivity as weeds invade the over-grazed bare spaces left in the sward and the productive pasture species population declines.

In the main growing season (June to mid-September), pasture growth is very rapid compared to feed demand and surpluses are quickly built. These large surpluses, combined with the lack of subdivision, offer high pasture allowances to livestock,

[34] These losses are calculated from measurements reported by Jiang et al. (1995a, 1995b, 1995c) in their study of pasture improvement using sheep night penning. Jiang et al. (1995a, 1995b, 1995c) reported that 2.4 kg of dung and urine per sheep was excreted in the night pen area being improved and that this combined dung and urine contained 0.35% P, 1.00% K and 0.95% N.

encouraging selective grazing. This lax and selective grazing removes the most productive plants from the sward because they are grazed more frequently and leaves large areas of rank, unpalatable pasture often containing mainly indigenous species. The high pasture cover that builds up increases the amount of shading in the sward, often shading out low growing species such as white clover, leaving bare spaces for weeds to invade when the pasture cover is lower. The result is very patchy pastures with small over-grazed areas and large under-grazed areas, and declining pasture productivity and quality potential.

8.2.8 Summary of problems

The combined impact of these problems results in an imbalance in pasture supply and feed demand, low net pasture production, declining pasture production potential, low feed efficiency, low levels of output and low farmer income. The central issue is the unsustainability of the majority of pastoral sub-systems in the study area as they currently operate. The declining productivity potential is due to over-grazing, under-grazing, selective grazing and the unbalanced transfer of nutrients out of the pastoral sub-system.

8.3 Technologies extended as part of the development project and the demonstrated production potential of pastoral livestock systems

The technologies described below were part of the demonstration/extension package central to the development project. These innovations were either based on research carried out within previous pastoral development studies in Southwest China (Section 6.5), or developed as part of the project. These innovations are not listed in any order of priority.

8.3.1 Phosphorous fertiliser

Several fertiliser trials were established as components of the development project at Bei Da Ying, mainly as a demonstration for local farmers and technicians of the benefits of fertiliser to pastoral systems. Results are shown below in Figure 8.9 and Figure 8.10 for one of these trials for the 1999 growing season from June to November. There is a clear yield response to phosphorous ($r^2 = 0.8934$), which has been identified as the most limiting soil nutrient after nitrogen, followed by potassium, for which a response can be observed within a level of phosphorous application.

All farmers in the project applied the Gaimeilin phosphorous fertiliser that was made available to farmers at a highly subsidised price by the project. However, the researcher is unaware of any farmer who purchased fertiliser for application to pasture outside of the project, even though all farmers involved in the project had observed the yield response to phosphorous at the trial sites and on their own farms. It was perceived from discussions with farmers that most farmers understood the benefits of fertiliser, particularly that of an increased carrying capacity.

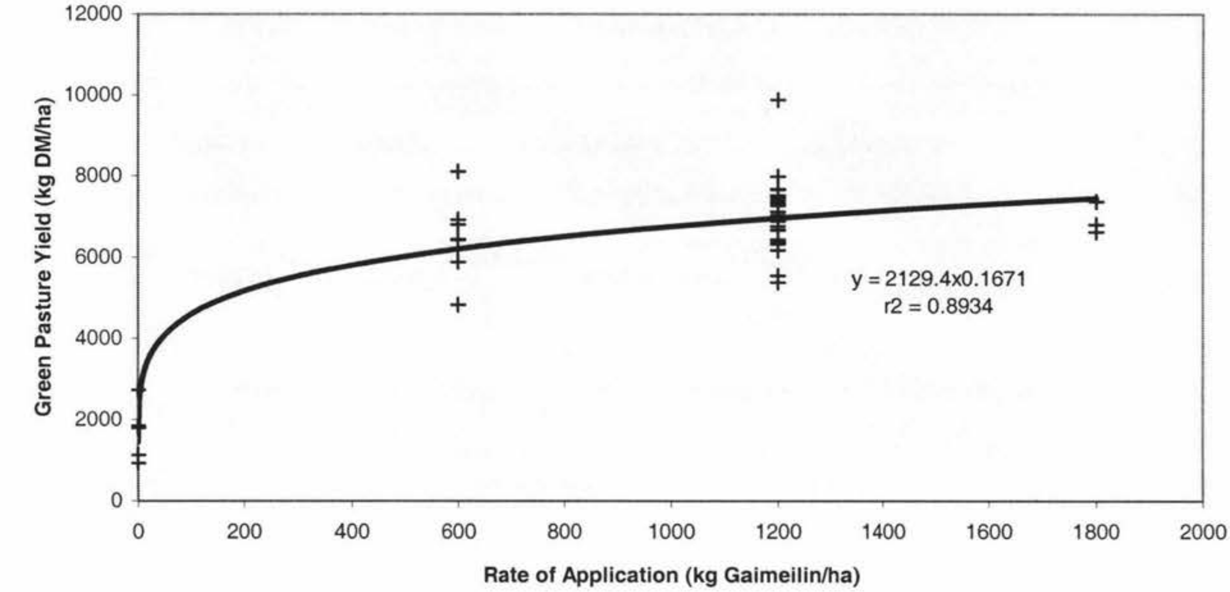

Figure 8.9: Green pasture yield from June to November 1999 versus phosphorous fertiliser (*gaimeilin*) application rate. Source: Fertiliser field trial at Bei Da Ying Pasture and Soil Research Centre. Significance: 0kg/ha p<0.005; 600, 1200 and 1800 kg/ha not significant.

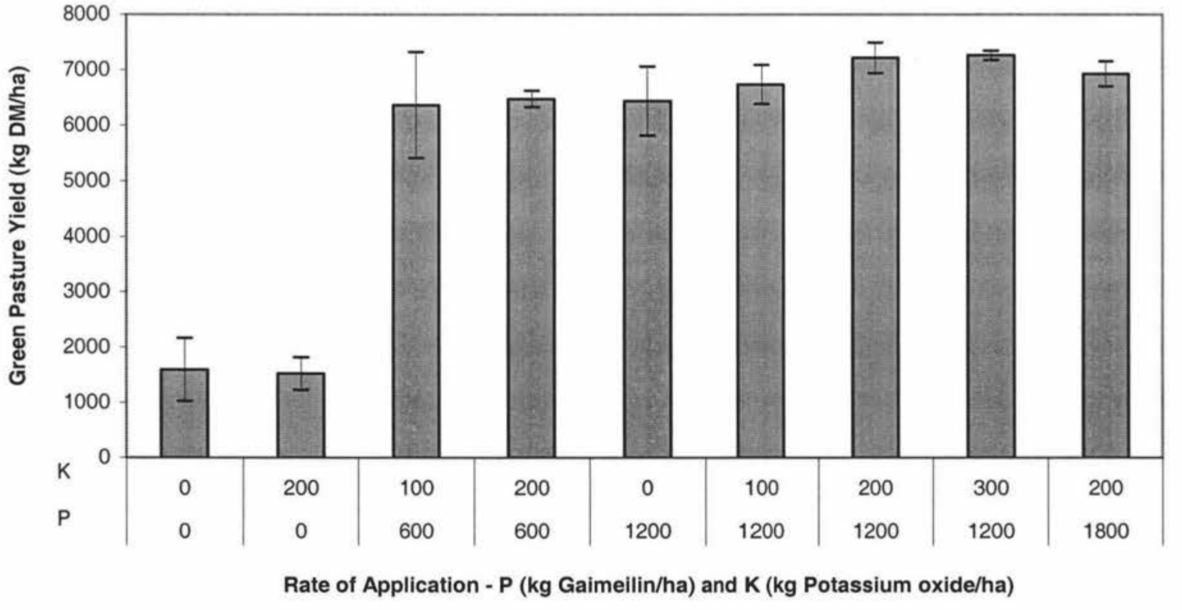

Figure 8.10: Green pasture yield from June to November 1999 versus fertiliser application rates for phosphorous and potassium. Standard errors are shown for each rate of application. Source: Fertiliser field trial at Bei Da Ying Pasture and Soil Research Centre.

8.3.2 New pasture species

The researcher's own experience suggests that three pasture species are well suited to the low fertility sites with highly seasonal rainfall such as Bei Da Ying, and also for sites with higher fertility such as Lang Mu Mountain. These species are cocksfoot (*Dactylis glomerata*), perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*).

Table 8.6: Sowing rate for new pastures at Bei Da Ying used in 1998–2000 in the project.

Species	Sowing rate (kg/mu)	Sowing rate (kg/ha)
Perennial ryegrass	0.7	10.5
Cocksfoot	0.5	7.5
White clover	0.3	4.5

The ryegrass often does not persist well in the low fertility and dry soils at Bei Da Ying, but is still planted to assist in the establishment of the slower establishing cocksfoot — the ryegrass prevents weeds from invading and provides a high pasture yield in the first year. In fertiliser trials (mixed grass and legume swards) where high rates of phosphorous have been applied, ryegrass grows more vigorously than in field conditions. The same is also true in species evaluation plots that have been invaded by white clover. This suggests that soil nitrogen levels are inadequate for sustained ryegrass growth. In the second season of a new pasture, cocksfoot provides the bulk of the pasture yield (pasture monitoring showed cocksfoot producing 40% of the pasture yield compared with 30% for each of perennial ryegrass and white clover on the Bei Da Ying demonstration farm)[35].

The high sowing rate for white clover is considered necessary to ensure an adequate plant population establishes to survive the difficult dry season.

For higher fertility sites, the perennial ryegrass and cocksfoot sowing rates can be reversed and the sowing rate for white clover can be reduced to 3.0 kg/ha. This sowing rate of 22.5 kg/ha is approximately five times higher than the sowing rates previously used to establish pastures at Bei Da Ying.

The resulting pastures were capable of producing 6000–8000 kg DM/ha/year, depending upon grazing management and amount of maintenance fertiliser applied.

All farmers involved in the project sowed new pasture, however the seed and capital fertiliser was provided by the project at a highly subsidised rate. Many of the Bei Da Ying farmers would like to continue sowing new pasture, but the lack of access to a tractor without project assistance makes it difficult to cultivate the soil in preparation for sowing.

8.3.3 Fencing

Fencing material such as netting is readily available, and plain and barbed wire is becoming more so. Steel posts are also available but are very expensive (25–45 RMB, depending upon the size). The traditional design uses netting and short untreated pieces of tree buried at no more than 250 mm. This design is easily damaged by livestock, easily stolen because the posts are so shallow (due to the

[35] Unpublished data collected during the research period at Bei Da Ying Demonstration Farm.

lack of spades[36]), and has a short useful life. Another traditional fence design is the "live fence" that involves the planting of thorny plants in rows, and these appeared to work effectively where they were well maintained.

On the demonstration farms the researcher wished to set up homogenous grazing areas to simplify grazing management and allow for greater management flexibility with paddock/land class specific management. On each of the two GGERI managed demonstration farms (one at Bei Da Ying and the other at Lang Mu Mountain), 13 paddocks were made. The researcher demonstrated New Zealand style post and plain wire fences, which should be more resilient, i.e., posts are buried 600–700 mm in the ground and the wires are strained tight with self-fashioned wire strainers. The design could be improved by using bamboo battens — bamboo is readily available at a low cost. These fences could be constructed for 5 RMB/m compared with the traditional netting fence costing 8 RMB/m.

Almost no farmers constructed fences on their own account during the project — only one farmer erected about 200 m of fence to subdivide one paddock into two. That farmer then had five paddocks, more than twice the average number of paddocks on other farms at Bei Da Ying.

8.3.4 Improved sheep genetics

Farmers felt that the rams available from the Breeding Farm were too expensive for them at 700–800 RMB each. Project farmers did buy half-bred rams (off-spring of ewes mated to Breeding Farm Romney rams) from the demonstration farm at Bei Da Ying for half that amount. There is considerable opportunity for new/improved genetics to be spread around the province in a similar fashion. Farmers suggested that the AHB and breeding farms needed to offer rams at lower prices so that farmers are more likely to purchase them. Farmers also noted that the AHB and breeding farms needed to make farmers aware of the availability and the advantages of using these rams.

[36] The researcher had to manufacture spades out of Dutch hoe blades for constructing project fences because spades could not be purchased.

8.3.5 Crop/pasture rotations

An alternative technique to traditional cultivation and immediate sowing of new pasture was developed, specifically for sites within the study area that have very seasonal pasture growth patterns and low base soil fertility, such as Bei Da Ying. The technique was also designed to recycle otherwise transferred nutrients back into the pasture sub-system. At the centre of the technique is the rotation of an area of cropping land around the pastoral area for the purpose of improving 5–10% of the pastoral area per year. The technique used successfully at Bei Da Ying that met the requirements of the whole system involved vetch, potato, corn and turnips (Figure 8.11).

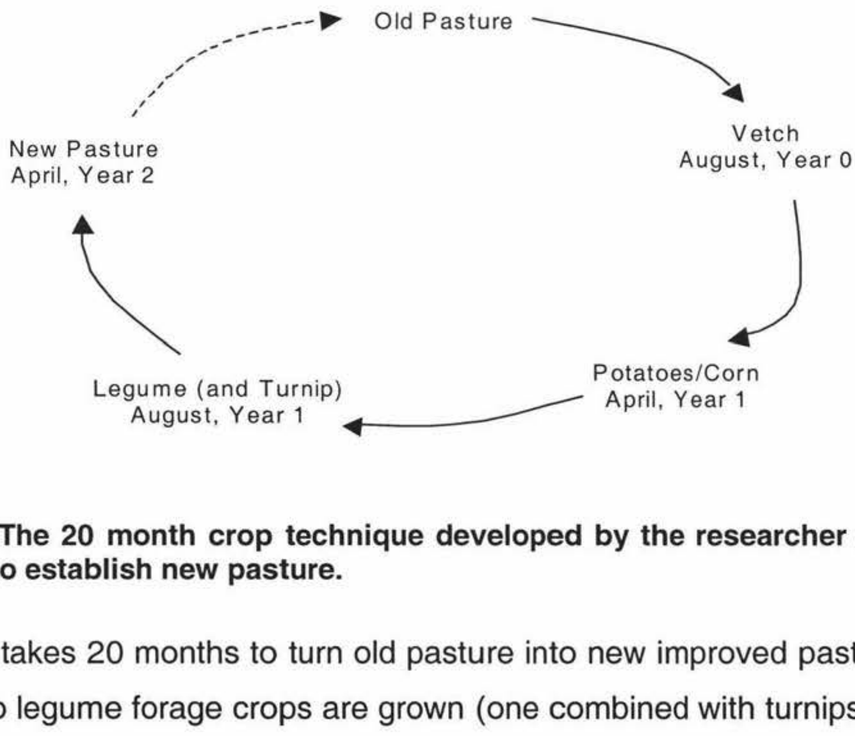

Figure 8.11: The 20 month crop technique developed by the researcher and used at Bei Da Ying to establish new pasture.

This system takes 20 months to turn old pasture into new improved pasture. During this time, two legume forage crops are grown (one combined with turnips to increase the forage yield) providing high quality, protein-rich winter and spring feed for livestock. One crop of potatoes or corn is grown to provide cash income, food for the family, or stock fodder (corn and corn residues). Crops such as beans can also be grown together with the corn if labour is not limiting.

The vetch is included because it is a traditional crop understood by local farmers, raises soil fertility by fixing nitrogen, and also improves the soil structure. Two vetch crops are grown, providing the equivalent of more than one full year of legume growth. The use of vetch at the beginning and end of the rotation also means that firstly, the initial cultivation takes place when the ground is moist (therefore more readily cultivated by hand if necessary), and secondly, cultivation for the new pasture takes place on previously cultivated land (again easier for hand cultivation). Such a rotation with non-pasture species for 20 months and multiple cultivations will help reduce the weed and pasture pest populations, thus assisting pasture establishment and sustainability.

A further advantage of the rotational system is that every 15–20 years, the whole farm can be renewed. During the years when the area is cropped, that area will receive a large amount of manure which returns the nutrients transferred to the animal housing area over the previous years under pasture, a mechanism by which nutrients can be recycled back into the pastoral sub-system from which they were removed. However, maintenance fertiliser is required to ensure the pastures continue to produce at a high level, though not at the higher level that is required (but not applied) to sustain the more traditional systems.

Pasture sown after the 20 months of cropping established more rapidly than pasture sown directly from indigenous pasture, with nearly complete ground coverage reached within two months of sowing. Traditional grass-to-grass methods typically required four months at Bei Da Ying. The new pasture sown after the crop rotation contained a higher percentage of grass species relative to white clover compared to new pastures established grass-to-grass. This is probably because of the higher nitrogen level of the soil as a result of the high levels of manure application and the contribution of the vetch via nitrogen fixation.

Farmers generally liked the 20-month rotation idea, and several would like to implement such a system, but are concerned about the impact an altered land use may place on their pastoral lease. These farmers planned to grow more vetch over the winter to lift winter forage supply.

8.3.6 Cattle

Goats and sheep are unable to readily eat summer reproductive pasture. Not only do they lack the ability to rapidly expand their intake as larger cattle do, but goats are browsers rather than grazers, and sheep graze lower in the sward. During the summer and autumn, these livestock classes can graze together without directly competing against each other, especially sheep and cattle, or goats and cattle.

Increasing cattle numbers on farms was one of the key innovations introduced through the project. Cattle provide the means by which rapidly growing reproductive pastures can be controlled, keeping the pasture conditions in the optimum range for maximum net pasture production, maximum pasture quality, and high animal intakes. Cattle appear to be critical to achieving these pasture and production targets and should be an integral component of any pastoral livestock grazing system in the study area and Southwest China.

The Bei Da Ying demonstration farm eventually (in 2000) carried 8.4 su/ha, plus lambs and calves in summer, with a sheep:cattle ratio of 64:36. Project management opposition to higher cattle numbers and possibly foot and mouth disease restrictions meant that the preferred higher cattle numbers could not be carried. Approximately half of the farm was well controlled (pasture covers maintained below 2200 kg DM/ha), while the other half was insufficiently controlled (rank pasture, higher dead matter content in sward, invasion of indigenous pasture species). This cattle stocking rate of one per 20 mu was higher than the Bei Da Ying average of one per 25 mu. The size of the summer surplus and the fact that only a small proportion of the demonstration farm was performing near expected potential, led the researcher and the demonstration farm management team to believe that a suitable summer cattle stocking rate is one per 10–12 mu, reduced back down to one per 20–25 mu in the winter/early spring period for the Bei Da Ying district.

The GGERI managed demonstration farm at Lang Mu Mountain carried 13.5 su/ha, with cattle making up 53% of the livestock carried[37]. This stocking mix allowed pasture cover to be readily maintained between 1400–2700 kg DM/ha over the summer period.

[37] Pasture production on the Lang Mu Mountain demonstration farm paddock by paddock ranged between 8,000–14,000 kg DM/ha. Peak pasture production in August and September reached 90 kg DM/ha/day. Pasture production on the Bei Da Ying demonstration farm averaged 6500 kg DM/ha, with the poorest paddocks producing about 5000 kg DM/ha and the best paddocks producing about 8000 kg DM/ha.

The supply of cattle in late spring and early summer is good, although most animals are sold individually, being targeted as future draught animals. The price for beef at the end of the summer/early autumn is high. Cattle grazing at Bei Da Ying and Lang Mu Mountain gained an average of over 600 g/day from May to October. This allowed for a gross return of 750 RMB per head in six months from finishing beef (assuming a purchase price of 5.00 RMB/kg and a sale price of 5.50 RMB/kg). A well-fed breeding cow (Yunnan Yellow) could raise a calf to 100–120 kg within seven months, which could be sold in October/November, but preferably carried over the winter for finishing the following year.

The largest benefit derived from higher cattle numbers (possible without reducing sheep numbers) is most likely to be the maintenance of the sward in a vegetative state, providing higher pasture quality throughout the pasture growing season which:

(i) Allows higher lamb growth rates and faster time to sale, lifting potential sheep carrying capacity; and

(ii) Maintains pasture production potential by encouraging the growth of productive species and discouraging the growth of indigenous and weed species.

Cattle also play a key role in controlling weeds and shrubs in recently developed pastures and preventing reversion back to native plant species.

Several Bei Da Ying farmers did increase their cattle numbers by half to double in 1999 and in early 2000.

8.3.7 Sheep night penning

The sheep night penning technique of improving pasture developed in Guizhou Province (Jiang et al., 1995a, 1995b, 1995c; Li et al., 1995) was used at the Bei Da Ying Demonstration Farm. Approximately 1 mu was improved using sheep night penning during the research period 1998-2000.

8.3.8 Grazing management

The central grazing management concept extended to farmers and technicians involved in the project was the use of pre- and post-grazing pasture cover targets.

Before the concept of pasture cover targets was extended, the problems associated with over-grazing, under-grazing and selective grazing were discussed with farmers, as were the underlying causes for these grazing practices (stocking rate, lack of cattle, lack of subdivision). An example of a pasture cover targets chart is shown in Figure 8.12.

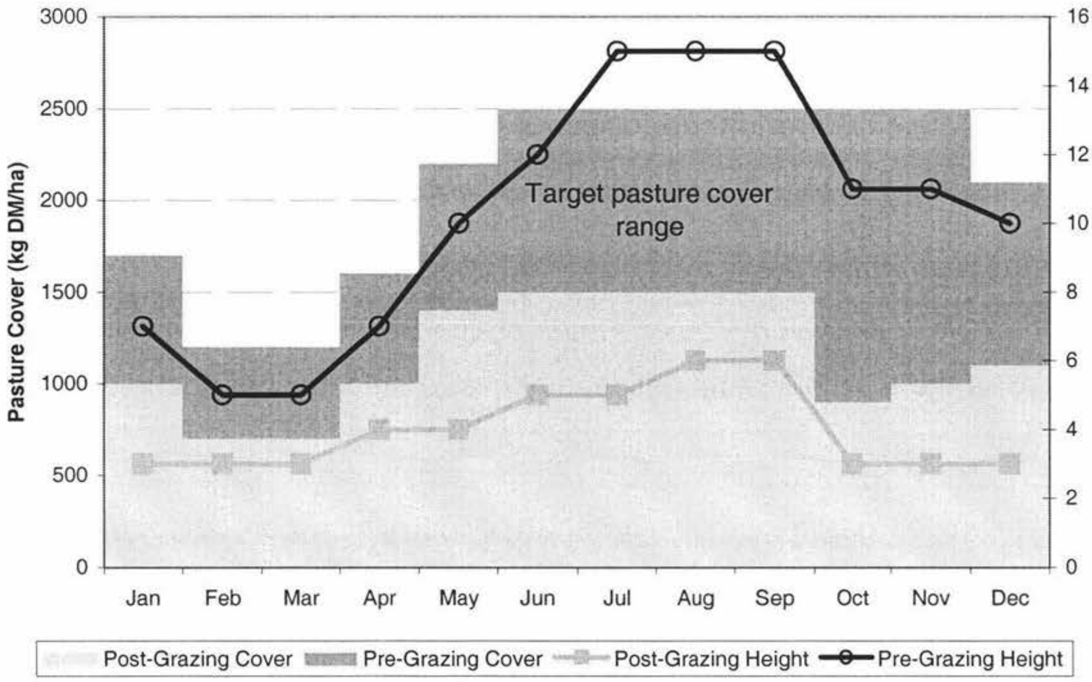

Figure 8.12: Example of pasture cover targets set for the Bei Da Ying demonstration farm's improved pastures grazing both sheep and cattle.

8.3.9 Controlled mating and spring lambing

As highlighted above, farmers appreciated that their lambing date appeared out of balance with the availability of pasture.

The demonstration farm at Bei Da Ying lambed in spring, but because of the large number of other changes made to the system in comparison to typical local existing systems, it is not possible to determine specific benefits accrued as a result of the spring lambing date.

One Bei Da Ying farmer lambed three times every two years (a lambing date cylce of August, April and December). He achieved a relatively low lambing percentage (75–80%) at each lambing. However, on average he was able to produce more lambs for sale per ewe (118% over 1998/1999) than any other farmer at Bei Da Ying.

Supplements played a very important part in the system, especially in December lambing years when ewes were expected to lactate almost entirely on supplements, and on any remaining rank pasture that had accumulated. This farmer estimated that he could raise his stocking rate by one third if he was to change his lambing date to spring from the current three times every two years, and that his reproductive performance would remain constant.

Another farmer at Bei Da Ying changed his entire flock to lambing in spring, and several other farmers were in the process of changing their lambing dates. These farmers all have better pastures than other farmers.

8.3.10 System summary

The pastoral livestock system demonstrated on the Bei Da Ying demonstration farm included all of the technologies mentioned above to at least some degree. Overall, the system design has:

(i) Improved pasture production and the match between pasture production and pasture demand (Figure 8.13) compared with the typical systems operated at Bei Da Ying (Figure 8.2);

(ii) Allowed stocking rate to double from 4.0 su/ha to 8.3 su/ha;

(iii) Enabled lambs to be finished to the same liveweight at sale within one production year rather than being carried through the winter, utilising an estimated 73% of the metabolisable energy required under the typical local system (Figure 8.14); and

(iv) Yielded an operating margin of 95 RMB/mu pasture (91 RMB/mu pasture plus supporting cropland, approximately a two-fold increase over a typical farm operating margin in the Bei Da Ying area) (Table 8.8).

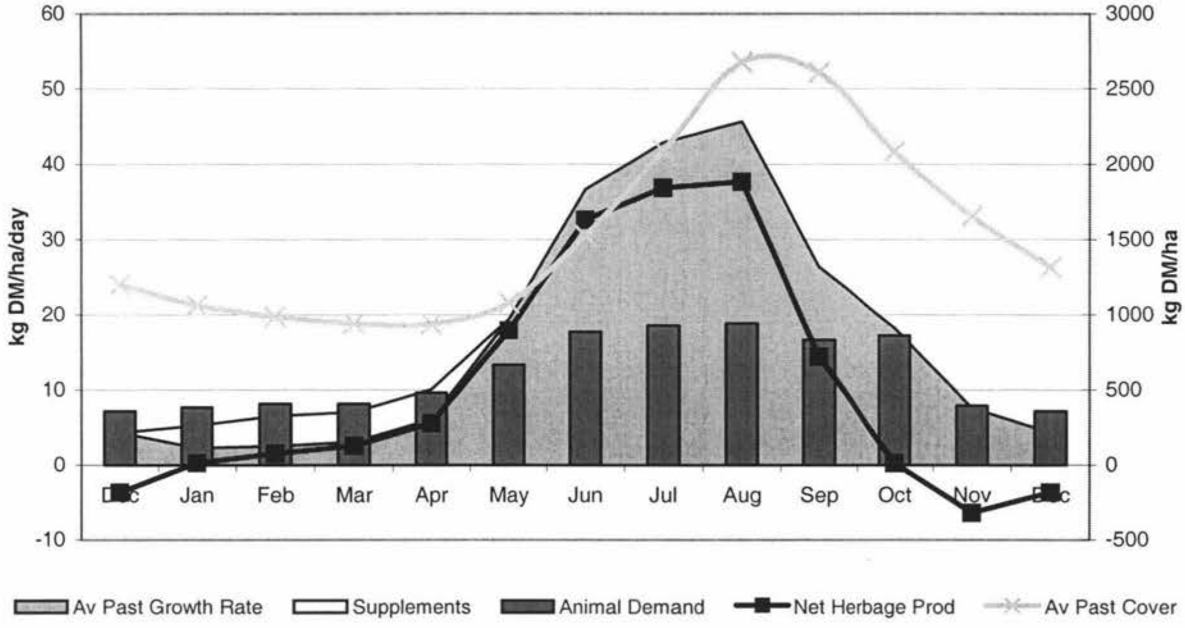

Figure 8.13: Bei Da Ying demonstration farm feed profile. Data sourced from monitoring of Bei Da Ying demonstration farm from April 1999 to April 2000. Net herbage production figures are calculated. Full feed budget in Appendix 2.2.

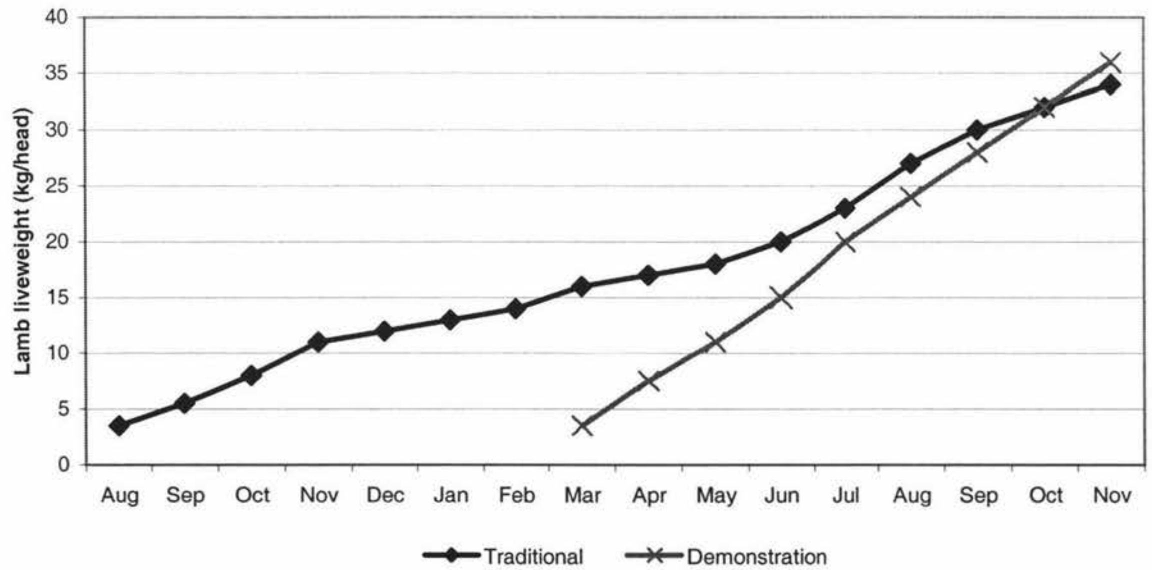

Figure 8.14: Lamb liveweight profiles for traditional autumn lambing (n=35) versus the Bei Da Ying demonstration farm where lambing is in spring (n=78), in 1998–1999.

The demonstration farm spring born lambs grew at an average of 135 g/day from April to November, twice the growth rate achieved by other farmers in the study area (68 g/day). These spring lambs required 2830 MJ ME (from all sources after birth) to reach a higher sale weight (36 kg), only 73% of the energy requirements of the autumn born lambs (3876 MJ ME, from all sources after birth, 34 kg) (Table 8.7). This higher level of performance is probably largely due to better feeding of both the ewes and the lambs throughout the year (offering a higher quantity of pasture and higher quality, more vegetative pasture), and the use of Breeding Farm rams with perceived higher genetic potential. The offspring of the Romney rams reached a sale weight 4 kg heavier than the Cormo offspring in November.

Table 8.7: Estimated metabolisable energy (ME) requirements of lambs raised to sale weight under the Bei Da Ying demonstration farm system compared to typical autumn born lambs. Lamb growth rates calculated from liveweight monitoring of lambs on one Bei Da Ying monitor farm (autumn lambing, n=35), and liveweight monitoring of lambs on the Bei Da Ying demonstration farm (spring lambing, n=78) in 1998-1999.

Farm System	Average Growth Rate (g/day)	Maintenance ME (MJ ME)	Growth ME (MJ ME)	Total ME (MJ ME)
Demonstration	135	1530 (54%)	1300 (46%)	2830 (73%)
Traditional	68	2656 (69%)	1220 (31%)	3876

The traditional and the demonstrated systems are compared directly in Tables 8.9 and 8.10. The figures for the demonstrated farm are adjusted to reflect a status quo system.

Table 8.8: Expected annual income statement for the Bei Da Ying demonstration farm (285 mu) based on 1999/2000 livestock numbers and performance and on 1999/2000 crop and pasture yields. Long-term income would be expected to rise as pasture production approached potential yields and livestock numbers increased accordingly.

Farm Revenue							
Livestock Sales							
	82	lambs	36	kg LWT @	5.50	RMB/kg	16,236
	20	ewes	40	kg LWT @	4.50	RMB/kg	3,600
	15	cattle	300	kg LWT @	5.50	RMB/kg	24,750
less Livestock Purchases							
	3	rams/2 yrs	400	RMB/head every 2 years			600
	10	cattle	150	kg LWT @	6.00	RMB/kg	9,000
Wool	100	ewes	5.5	kg/ewe	7.50	RMB/kg	4,125
Corn	250	kg			0.75	RMB/kg	188
Gross Farm Income							39,299
Operating Costs							
Sheep Health	100	ewes	5	RMB/ewe			500
Cattle Health	25	cattle	5	RMB/head			125
Vetch	15	mu	40	RMB/mu			600
Potatoes	3	mu	50	RMB/mu			150
Maize	12	mu	110	RMB/mu			1,320
Pasture seeds	15	mu	52	RMB/mu			780
Cultivation	15	mu	90	RMB/mu			1,350
Capital fertiliser	15	mu	50	RMB/mu			750
Maintenance fertiliser	270	mu	27	RMB/mu			7,290
Salt							300
Total Farm Operating Expenses							13,165
Average Operating Margin							**26,134**
plus personal consumption of potatoes, corn							1,088
TOTAL AVERAGE OPERATING MARGIN							**27,222**

LWT = liveweight

Table 8.9: Physical performance of traditional smallholder farms and the improved system demonstrated at Bei Da Ying. Based on 100 mu of pasture and 12 mu of cropping land. The demonstration farm performance is adjusted to a status quo system.

	Traditional	Demonstration
Ewes	22	35
Hoggets	7	9
Rams	1-2	2
Lambing % to sale	80%	110%
Lambing date	Aug-Sep	Mar-Apr
Ewe liveweight (average)	40 kg	48 kg
Ewe liveweight at mating	35-55 kg	40-55 kg

Lambs sold	12	28
Lamb liveweight at sale	34 kg	36 kg
Lamb age at sale	12-15 months	8 months
Cattle	4	9
Cattle sold	2	6
Cattle liveweight at sale	250	300
Stocking rate (su/ha)	4.5	8.4
Total herbage intake/ha/year	2450 kg DM	4476 kg DM
Lamb ME requirement to sale	3876 MJ/lamb	2830 MJ/lamb

Table 8.10: Summarised financial performance of traditional smallholder farms and the improved system demonstrated at Bei Da Ying. Based on 100 mu of pasture and 12 mu of cropping land.

	Traditional	Demonstration
Farm Revenue		
Livestock sales		
Lambs @ 5.50 RMB/kg	2244	5544
Ewes @ 4.50 RMB/kg	473	1260
Cattle @ 5.50 RMB/kg	2750	9900
Pig @ 4.00 RMB/kg	480	480
Livestock Purchases		
Rams	200	300
Cattle	1800	4000
Pigs	450	450
Wool	908	1444
Tobacco (expected revenue)	1300	0
Other Crops	150	200
Gross Farm Income from livestock & crops	*5855*	*14544*
Operating Costs		
Animal health	160	250
Cropping	2472	2700
Salt	100	150
Pasture establishment (7% of pastoral area)	0	1350
Maintenance fertiliser	0	2700
Total Farm Operating Expenditure	*2732*	*7150*
Operating Margin	**3122**	**6928**
plus personal consumption of crops	*1710*	*1710*
Net Operating Margin	**4832**	**9324**
Net Operating Margin/mu (pasture)	*48*	*86*
Net Operating Margin/mu (pasture & crop)	***43***	***77***

8.4 Constraints to pastoral livestock system output

8.4.1 Farmer perception of control and farmer learning

Many farmers did not believe they had the ability to control outcomes on their farms, particularly at the strategic and tactical management levels. For example some farmers did not feel they knew the type of animals wanted by "the market" or when the best time to sell them was, highlighting the lack of market information access. Some farmers did not feel that they could always fully feed their livestock, and some farmers did not believe they had sufficient tactical options available to cope with between-year climatic differences, or that they could manage pasture quality by adjusting their livestock numbers and livestock classes. However, most farmers appeared to believe they had control over operational aspects of their farm. For example, most farmers felt they could prevent animal health problems, control the time of lambing, and achieve high crop yields by applying sufficient fertiliser. Farmer locus of control is described in more detail below in Section 8.5.4, where survey results are reported.

Technicians and farmers alike tend not to focus on how to better manage and take some control of those aspects that are currently perceived to be externally controlled, but rather on those aspects already well managed.

One technician/extension worker believed that the best way to encourage farmer adoption and change was more frequent and regular contact with the farmers by extension workers living and working in the targeted villages for long periods of time. He suggested this would build up trust, encourage farmer participation in research, and allow the extension worker to learn about the issues facing farmers. This technician felt that farmers needed to own and manage the demonstration farms rather than have them managed by AHB or project staff. Other technicians and extension workers felt that extension was not really their role, and/or that extension was a waste of time because of farmer stupidity and opposition to change. There is clear opportunity for both extension workers and farmers to learn. Some technicians also appear to feel that their salary was too low to warrant extended fieldwork and the difficult conditions encountered when working with farmers. The researcher observed that such technicians tended to avoid or at best neglect fieldwork and farmer extension.

8.4.2 Cropping and land use

Mixed cropping farmers have renewed interest in livestock production, especially grazing livestock such as sheep, goats and cattle, even with quite large declines in product prices (particularly wool) in recent years.

Prior to the recent change in land use from tobacco to food crops (Section 8.1.3), food production land had been under pressure from urban expansion (although this pressure is not felt directly by farmers at Bei Da Ying because of the remoteness) and was also in direct competition with livestock forage crops. This pressure on food production land has been almost eliminated in many districts, especially those with pasture land, because of the change in land use from tobacco to food production. However, the area used by each farmer for cropping is still limited as follows:

(i) Manure and fertiliser availability limits total area, and can be crop specific, as farmers aim to achieve maximum yield from the areas they do cultivate to ensure labour efficiency.

(ii) Labour availability is also constraining; unpaid (non-family) labour is available, but only at a cost that is considered unprofitable by farmers. Farmers interviewed in this study claimed that other farmers with less land or without pastoral land refused to work cultivating crop land for less than 20 RMB/day, the rate available working on construction sites in large urban centres, regardless of whether this urban work was available to them or not.

(iii) Cropping land is allocated to farmers by the township and village governments, thus this land is virtually guaranteed to farmers, while pastoral land must be leased from the village authorities for a fee. These lease terms are supposed to be 30 years, but frequently terms are reduced with no refund — an occurrence that is feared by some farmers. As a part of this fear, farmers are afraid to change the pastoral land's land use in case that causes village authorities to cancel their lease. Pasture is considered an exclusive land use by officials, and the process of obtaining legal authority to change land use, even on a temporary basis, appeared to be long and arduous. Bei Da Ying village pastoral leases are currently for 10 years (from 1997 until 2007) and cost 45 RMB/mu paid at the start of the lease.

(iv) Many farmers also feel that to cultivate pasture for crops is a waste of the money invested in the pastoral development, although this development has been largely of very poor quality due to inappropriate techniques being used, and in many areas such as Bei Da Ying, the cost of such development was borne almost entirely by the state. Several other issues may also have influenced farmers to not crop pastoral land — hand cultivation of pastoral land in spring is difficult and tractor cultivation is expensive and not readily available without the existence of development projects. Further, there is no security for crops grown away from the hamlets or residential areas (see Section 8.4.4 below).

From a farm system research perspective, this also creates difficulties when working with local partners who perceive the pastoral livestock and cropping sub-systems as being separate. This view neglects to consider that the farm family labour must be shared between the two sub-systems, that the crops are often grown to feed the grazing livestock in times of feed deficit, and that considerable nutrient transfers occur from the pasture areas to the cropping areas.

8.4.3 Climate

The extreme seasons occurring at sites such as Be Da Ying place obvious constraints on pastoral and cropping activities. The cold, dry winter was cited as the reason for heavy reliance on supplements during this period. However, during a discussion on livestock feed demand and pasture production profiles, farmers appreciated, but also found amusing, that these two profiles are nearly opposite to each other (Figure 8.2). The stated reasons behind what appeared to be a conflict between the environment and farm management are:

> *"Ewes must be well fed during pregnancy, thus pregnancy should be timed to occur in summer and early autumn when pasture growth is high"*
>
> *"Weather conditions are more stable in autumn than in spring and this ensures a higher lamb survival than lambing in spring"*
>
> *"In summer, the livestock, especially the lambs, are older and heavier so they can eat more pasture"*

> *"Autumn lambing gives young stock more time to grow and makes it easier for sale liveweight targets to be achieved"*
>
> Bei Da Ying farmers

The farmer at Bei Da Ying who lambed three times every two years claimed that climate was not such a significant constraint in the study area with respect to lambing date.

Livestock feed demand follows pasture cover more closely than matching pasture growth. Matching pasture growth is the preferred practice in New Zealand. This mismatch of pasture production and livestock demand required farmers to produce more supplements than would otherwise have been required with a spring lambing, but farmers generally perceived that this led to a lower risk system.

Pasture surpluses readily built up during the monsoon season. However, because of the frequent rainfall events it is very difficult to conserve these surpluses as either hay or silage.

Although rainfall is moderately reliable, the commencement of the monsoons from year to year could be quite variable. This has two effects. First, on feed supply during lactation in the spring lambing systems, and second, on the ease with which new pastures could be established in spring. Early monsoons meant the soil became too wet very quickly for cultivation, and late monsoons meant either serious wind erosion of cultivated land or desiccation of sown seeds. Lack of soil compaction post-sowing further compounded the problems with pasture establishment.

8.4.4 Security of livestock

Farmers take their livestock home each night because the animals are not safe from thieves, and in winter the temperatures are very low. Some farmers even take them home at midday when they return home for a meal.

> *"We used to graze our sheep all day and night, except in winter. Wild dogs used to catch and kill them sometimes, but now the dogs have all gone, it is*

people stealing our sheep, which is much worse because we cannot stop that. So now we have to take our animals home every night."

Bei Da Ying farmer

8.4.5 Soil fertility

The plateau area surrounding Bei Da Ying has suffered repeated nutrient removal, as have many other similar districts throughout Southwest China. The first large-scale removal of nutrients occurred when the forests were cut and used to fuel industrialisation during the Great Leap Forward (1958). After the deforestation, human activities such as cropping and the physical removal of topsoil, and wind and water erosion resulted in further soil losses. Now sown in pasture for up to 15 years, these areas have continued to lose nutrients to cropping areas with animals being housed off the pasture. Measurements made within the project show Olsen P levels in the area to be between 4 and 8 units.

8.4.6 Water supply

Water is scarce in China (e.g., Brown, 1995), and water storage facilities are not well developed. At Bei Da Ying, a water system for the village centre has recently been constructed. Previously, water was carried by hand from a semi-natural dam built in the mid-1990s. Many farmers who live in the hamlet areas continue to rely upon hand carried water for personal use — very few have water storage tanks supplying their households. Livestock must be taken to drink from this dam or several smaller dams every day. The lack of water on individual farms means that in the dry season, regardless of whether livestock could be left to graze pasture for 24 hours, they would still have to be taken to water each day. Farmers identified this lack of water as being a further reason why the animals should be taken home each night, and also another reason why subdivision is not widely adopted by farmers.

8.4.7 Investment in farm development

Without investment in their pastoral land such as fertiliser and subdivision, it is difficult for farmers to raise or even maintain their output, particularly because of such problems as nutrient transfers as described in Section 8.2.

Farmers stated that guaranteed land tenure, subsidised input prices and higher product prices would encourage them to invest in pastoral development. Several farmers also mentioned that they were unable to fund such development from cashflow and equity, but would invest borrowed money if credit were available to them. In 1998, there was little interest from farmers in how to increase pasture production and increase sheep productivity, but in 1999 and 2000 with the changes that occurred in the tobacco sector and flowed through to all other crops, there was much renewed interest from farmers in these subjects. Farmer discussion group attendance at Bei Da Ying increased to over 90% in late 1999 and early 2000 compared with about 50% in 1998. However, a reduction in subsidies for inputs provided by the project in 1999 and 2000 saw farmer use of these inputs decline significantly; some farmers asked for less land to be cultivated and applied the same amount of fertiliser and sowed the recommended sowing rate, while others cultivated more land but sowed less seed and applied less fertiliser.

8.5 Constraints to farmer investment and adoption of innovations

During discussion groups and in interviews, Bei Da Ying farmers cited low prices and market uncertainty as the largest disincentives to investing in the further development of their pastoral land. A second reason for not investing was security: security of land tenure and security of fixed assets. Farmers perceived the returns on such investments to be long-term.

Most farmers appreciated the productivity and production gains that could be realised if they changed their farm system and invested in farm development, but most of these farmers also doubted that the financial returns would pay for the cost of such development.

> *"The risk that the extra income earned from owning more sheep would pay for the cost of sowing, establishing, fertilising and maintaining the pasture necessary to carry the higher number of ewes is too high"*
>
> Bei Da Ying farmer

8.5.1 Markets, infrastructure and information

Farmers perceived that livestock dealers controlled livestock markets and that there was no means of them gaining greater control over prices received for livestock and livestock products. Most farmers claimed that these dealers *"have no loyalty and cannot be trusted"* and that they are *"only after today's profits at the expense of us the farmers".* Subjective researcher observation suggests that these farmer claims are well founded. The researcher saw cattle dealers arrive in a small village, sometimes with a truck, but usually without, to offer a price and a quota to be met before buying any animals at all. For example, the dealer may specify that all deals are conditional until eight animals can be purchased. The dealer visits are usually timed to coincide with the onset of the dry season or other periods when stock fodder is in short supply. Such practices will be able to continue unchecked because of the lack of accurate market information available to farmers in remote areas, and their remoteness from markets.

> *"Gaining access to price and market information is very difficult for us at Bei Da Ying because no prices are published anywhere. The Animal Husbandry Bureau workers have little information and it is usually old, and the dealers who come here cheat us. So, we must travel to Xun Dian ourselves and go to the livestock market, but even then the people there may cheat us because they are looking after themselves."*
>
> Bei Da Ying farmer

8.5.2 Security of land and property

Farmers at Bei Da Ying also had reason to feel concerned about the certainty of their land tenure. Their pastoral leases are for 10 years only, when in most other regions pastoral leases are for 30 years in accordance with state decree. One farmer lost some land so that a village official's son could have it. The farmers are concerned that if the village government should change, the village government will cancel all pastoral leases and reissue them upon payment of a new fee, because these new officials will have little or no income for the village administration. They are also concerned that if they develop their land too much and productivity increases markedly, then the village officials may wish to charge more for rent in the future (i.e., productivity-based rental fees), or cancel and reissue the leases with productivity-based rental fees.

Fences often suffered a similar fate as livestock left out grazing. It was commonplace for a newly erected fence to be either seriously damaged or stripped and stolen within the first couple of nights. Pasture monitoring cages were also good targets for theft, possibly to be used as chicken coops. Such theft, particularly of fencing, is another significant disincentive to invest in development to intensify pastoral production systems.

A unit within the AHB called the Pasture Security Unit, responsible for monitoring pastoral farming activities is officially charged with protecting pastoral land from illegal grazing and with protecting livestock and fixed assets from theft. Farmer comments and researcher observations suggest that this unit is relatively ineffective in both these roles. At Bei Da Ying, it appeared that much of the theft was caused by poverty, but not always, because many of the people believed to be responsible for the theft were the same ones who declined the offer of paid labour cultivating land for crops but were otherwise underemployed. Some farmers and technicians believed that material such as fencing was stolen because the thieves knew or thought that government funding had been used to purchase it and felt that they themselves were neglected by the state.

The researcher also identified the lack of scale as being a constraint to farmer ability to develop and invest. Larger scale is difficult for individual farmers to attain because of current land policy.

8.5.3 Finance

Many farmers identified lack of finance as a major constraint to further development, system intensification and income growth. Most of the project farmers were above national and provincial poverty lines, and were relatively asset rich compared to landless rural residents. This excluded them from poverty alleviation project micro-finance schemes if and when they existed. Conversely, the main commercial banks do not consider these farmers asset rich, but rather that their collateral is insufficient and their cashflow too risky. One farmer interviewed claimed to have approached one of the main trading banks in 1999 (China's economy was suffering from deflation in 1999) and to have been offered a loan at a rate of 13.2%, which he rejected. Several of the general stores in the Bei Da Ying village offered local farmers credit on goods purchased from them, and sometimes even offered cash advances. There did not seem to be any interest charged on goods purchased on credit, and payments were made during the year, with all debts cleared before the end of the year.

Several farmers mentioned during interviews that they would like to build secure brick livestock houses (as opposed to more simple earthen shelters) on their farms to reduce livestock energy expenditure and wastage of valuable grazing time used in walking livestock to and from their own houses each day. However, these farmers also claimed that they did not have sufficient finance readily available to fund such construction work. Farmers also considered that skilled labour was relatively scarce.

8.5.4 Farmer locus of control

To understand why farmers adopt, or do not adopt, certain practices it is important to first understand which aspects of their farm production systems and farm businesses farmers perceive and believe they can exert control over, or influence in some way.

Responses to the 25 questions specified in Appendix 3.2 are shown in Figure 8.15. Those questions for which 80% or more of respondents returned the same answers were eliminated from further analysis (Kaine et al., 1994). This left 10 questions: Question 3, 4, 7, 9, 10, 16, 17, 18, 19 and 25 (Table 8.11), relating to feed planning, business planning, expansion, pest management and marketing, which represent areas of strategic and tactical management.

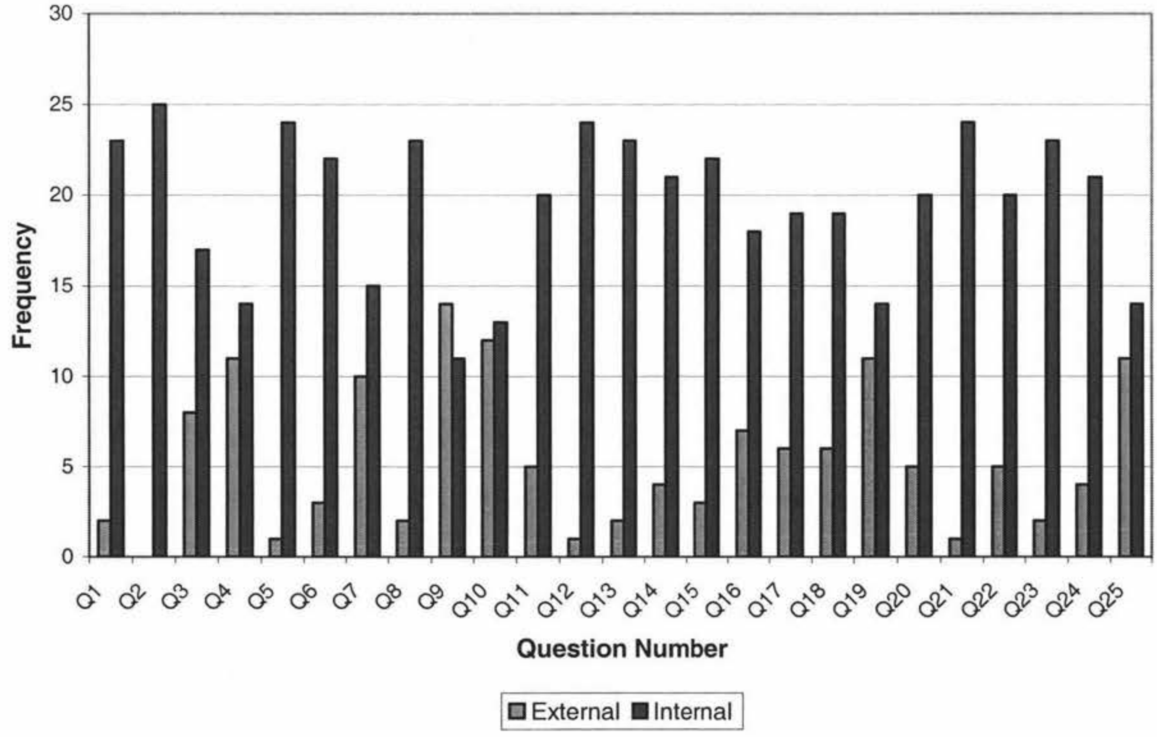

Figure 8.15: Farmer responses to locus of control survey (n=25, farmers from the project sites Bei Da Ying and Xun Dian County).

Those aspects upon which farmers had greater consensus with respect to an internal locus of control were generally operational and tactical aspects of farm management, although most farmers perceived value in determining their own strengths and the strengths of their farms, as well as identifying threats and opportunities facing the farm business.

The responses to these 10 questions for which no consensus was formed were aggregated to create one index of internal control, "Internal Control Response Percentage". "Internal Control Response Percentage" was plotted against lambing percentage to sale (Figure 8.16).

Table 8.11: The 10 locus of control survey questions to which fewer than 80% of farmer respondents returned the same response (n=25, farmers from the project sites Bei Da Ying and Xun Dian County). Italicised statements exhibit an internal locus of control.

Question	Statements
Q3.	Even in today's economic conditions there are frequent opportunities to expand, develop and intensify my farm The current economic conditions make it very difficult to further develop my farm
Q4.	Because each year is different from the last, I prefer to set up a new plan each year Because farming is such an uncertain business, I find it is best to follow fairly closely the plan I have used in recent years
Q7.	In my situation, it is difficult to plan activities in advance because most of the factors that influence timing of events are out of my control It is generally possible to plan activities ahead of time and fine-tune exact timing based upon climatic conditions at the time
Q9.	I generally find that even though climatic conditions change from year to year, I can still make improvements to both my cropping and pastoral systems' performance For a farm like mine, it is very difficult to make improvements because the seasonal conditions vary so much between years
Q10.	I have found that I can minimise the effect of plant pests and diseases on crop yield by using crop rotations I have found that the incidence of plant pests and diseases depends more upon the season rather than my management practices
Q16.	I know the type of animals the market requires and usually receive some reward for providing those animals at a time when demand is high In my situation, there is no advantage in trying to guess the type of animals with the highest value as it is very difficult to know what sort of animals the market requires and when they are wanted
Q17.	In my experience, I have found that pasture quality and animal performance can be improved by changing the mix of livestock grazed On a farm like mine, seasonal conditions do not allow pasture quality to be managed
Q18.	In my situation, there is no advantage in timing events such as lambing and buying and selling animals to better match pasture supply and feed demand because markets are out of my control In my experience, changing animal feed demand to match supply usually provides significant financial advantages
Q19.	In my experience, I can always ensure sufficient feed on hand to fully feed my livestock For a farm like mine, it is very difficult to ensure an adequate feed supply over the whole year because the pasture growth is so seasonal
Q25.	I frequently use market information to adjust my farm plan I do not use market information in making decisions because the information is often out of date or inaccurate

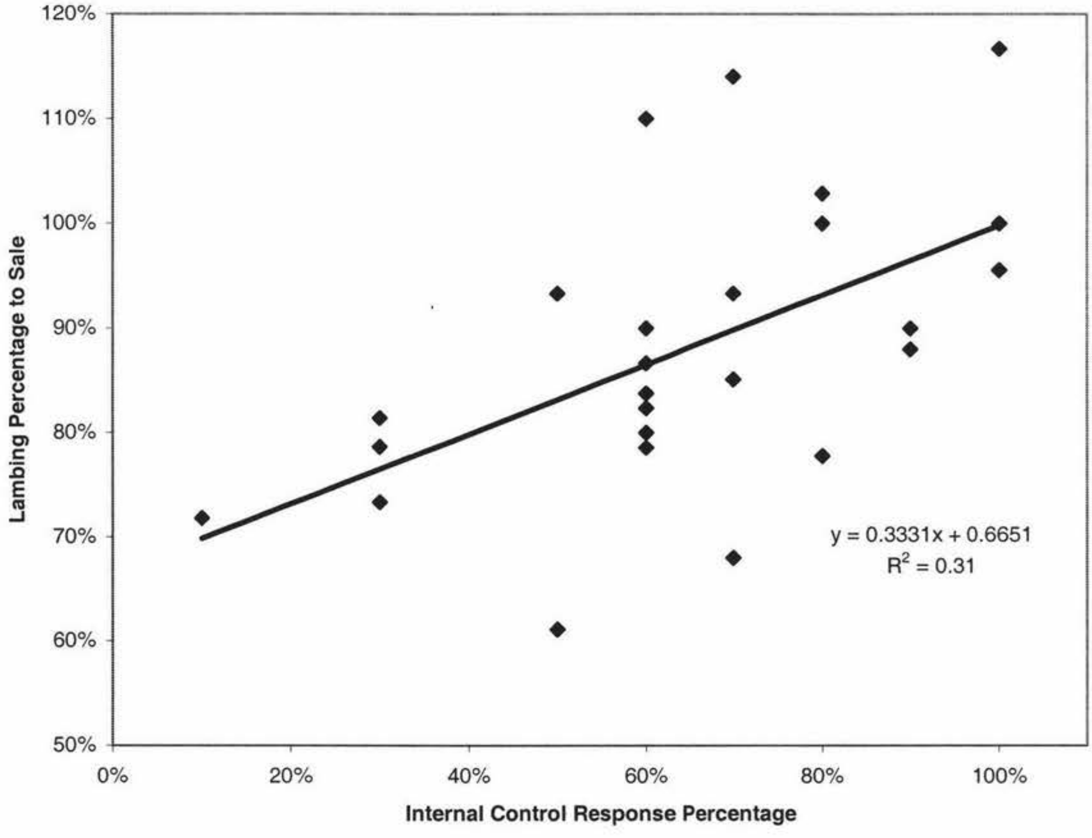

Figure 8.16: The fitted linear relationship between farmer internal locus of control and farm performance, for farmers from Bei Da Ying Village and the Sheep Breeding Farm (n = 25, p=0.004).

A group of eight technicians working within the project across all three sites were also asked the same group of questions. These technicians were asked to view the questions from their perceived farmer perspective based on their own experience in managing trials, demonstration farms, and extension. Two technicians perceived a low level of internal control, while the other six technicians perceived that farmers are able to control most aspects of their farms covered by the survey. The technician's responses to the 25 questions are shown in Figure 8.17.

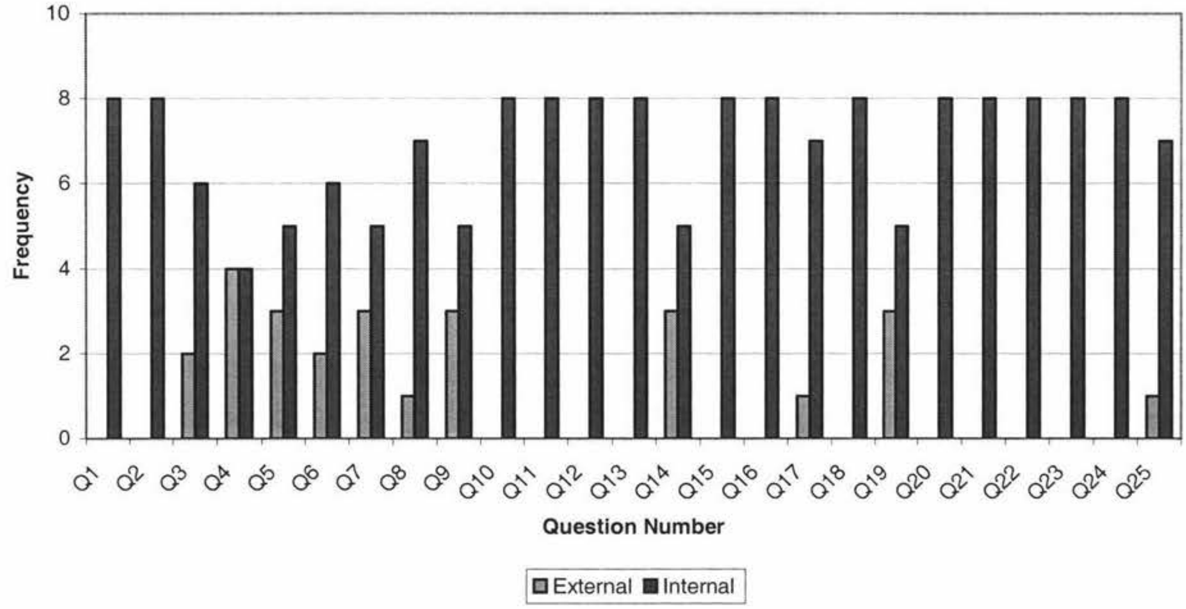

Figure 8.17: Technician responses to locus of control survey (n = 8, technicians from the three project site Bei Da Ying, Xun Dian Sheep Breeding Farm and Lang Mu Mountain).

8.6 External factors impacting on realised farmer income

8.6.1 Market access and demand

The primary determinant of farmer income from increased output is whether there is an adequate demand to sustain the original or better margins. The researcher observed many development projects that had been implemented around China that had been very successful in boosting output, but had failed to ask whether the market wanted what was being produced, only to find out several years later that the market did not in fact want that level of output at those prices. Discussions with other development workers suggested that this phenomenon is not confined to China.

8.6.2 Market information

Another determinant is whether farmers can receive timely and accurate market and price information so that they can adjust their systems to minimise negative events and maximise gains from positive events. The information void is large in China's red meat sector, as illustrated by the above mentioned farmer frustration with marketing their livestock.

8.6.3 Infrastructure

Infrastructure may prove inadequate to transport produce to the markets on time or in good condition. Distances to markets in China can be very great and the lack of refrigerated transport excludes many products from many markets. For example, meat produced in Yunnan is excluded from the higher value eastern markets, even if original meat quality is high enough, unless it is either dried or smoked.

8.6.4 Land policy

Local government policy on land is uncertain, regardless of the directives issued from Beijing. Output-related lease prices, which are a possibility, would reduce the return farmers receive on their own investment in land, because the increased rental would negate a portion of the income derived from increased output.

8.6.5 Disease

Another serious threat to farmer incomes and survival is disease. For example, in 1998 and 1999, Foot and Mouth Disease (FMD) was been detected in all but four of China's provinces, and was particularly widespread in Yunnan Province. A similar outbreak of FMD or another disease could directly affect farmers by requiring their livestock to be slaughtered with little or no compensation, or indirectly by either scaring consumers and reducing demand or regulations being enforced to stop the trade in livestock as a disease prevention measure.

9 Discussion

9.1 Lessons learnt regarding the research methodology

During the research process, write-up and evaluation the researcher was able to reflect on the process and the on broader development project. As part of this reflection process, numerous observations and lessons were recorded. These are provided below:

(i) Data requirements should have been clearly identified before going to the field – a RRA approach may have assisted to broadly scope the issues that needed greater in-depth analysis and study. This was not done well in this study because the research question was not defined until after a considerable time in the field.

(ii) Methods for data collection should have been determined and a framework for data collection and analysis established before starting data collection.

(iii) The researcher needed to ensure that all participants in the research understood the purpose of the research and the time commitment/other resources that would be required. The researcher did ascertain when participants (especially farmers) were available, because case study research is very time consuming and farming involves many seasonal activities. Greater openness and communication could have facilitated planning the research process and possibly ensured that officials were more supportive of the study. Upon reflection, this lack of openness occurred not because of a lack of trust, but rather because the research was not certain as to the shape the research would take or even the research question until well into the project posting.

(iv) A definite boundary was not put around the case until quite late in the research process. This was because of the uncertainty surrounding the research methods and design. Earlier identification of the case and the research question could have meant that the case was selected to answer the research question asked (this also links with the next point).

(v) Less data from more farmers may have been confused with increased quality or generalisability of the findings. The opposite is probably the more likely outcome because case studies and qualitative research are not supposed to yield widely generalisable findings. More rigorous data collection, richer data and improved understanding and analysis could have resulted from concentrating on several individual farm families as cases rather than at a village level. This could have been achieved if purposive sampling had been used to select "information-rich" cases within the Bei Da Ying village case actually researched.

(vi) The research question was very broad. Had the research question been more focused and tight, the study could have been completed far more readily, and some of the difficulties surrounding the methodological pluralism may not have been encountered. This would also have meant that the researcher was able to concentrate on the methods being used and not be trying to understand numerous bodies of knowledge even though that was very interesting and expanded the researcher's understanding.

(vii) Before departing for China, the researcher had no knowledge of Chinese language. This constrained the speed of acculturation and probably severely reduced the rate at which the research could be undertaken. Not only would being able to speak Chinese have enabled ready communication with participants and sped up data collection, but could have improved the quality of data collected as it would remove interpreter interpretation and translation biases. Being able to speak and understand the participants' language would have allowed for more spontaneity in the interviewing process and greater use of exploratory "why" questions. Further, once the researcher developed a degree of language proficiency, many key informants became more open, trusting and accepting, possibly because of the direct communication or the greater length of time the researcher was known. Learning the language of the people whom you are researching appears to be quite critical to ensuring common understanding, building trust and being able to explore in detail the situation studied.

(viii) Milestones should have been set for key research questions/objectives, and the reports written up for each objective/question as data was collected. That way the findings and understanding would have been collated in a structured manner that could assist in the next steps of the research and any gaps in the data can be highlighted while there was still the opportunity to collect the data required to fill such gaps.

(ix) Researching a context in which the researcher was working in (especially such a real-life development situation) was extremely difficult and fraught with many limitations (e.g., conflicting objectives for time in the field; getting "too" involved in doing the work and solving participant's problems which caused the research to be neglected). This type of research was essentially action research. The researcher now has an appreciation of the considerable planning and control that are required to ensure that all necessary data is collected, recorded and reported. It appears vital that the researcher is able to extract themselves from solving participants' problems when in "researcher mode" to obtain more objective and rigorous insights.

(x) The development project the researcher was working on was not sufficiently flexible to allow changes as research findings become available. This meant that it was not possible to test new theory from the research and frustrated the researcher. This would seem to be one of the greatest challenges for researchers *working and researching* in developing countries where a top-down approach has been used to establish and design the programme (development project) being researched within.

In summary, there would have been enormous value had the researcher been able to spend about six months preparing for the research project. This time could have been spent learning Chinese language, a short period in the field to scope out issues and gain a basic understanding of the research context, and most importantly define the research question, identify data requirements and establish a case study protocol that specified milestones, the research design and data collection methods.

9.2 The vicious cycle of unsustainability and confidence

The farm families at Bei Da Ying are not readily able to meet their goals of having improved livelihoods. These farm families are struggling to grow capabilities and capacity and are earning low incomes. This is especially the case for families with very small pastoral land areas. In response to this situation, they are operating farm systems that are degradating their natural resources. These farm families are in a vicious downward cycle of unsustainability and weakening of livelihoods (Figure 9.1).

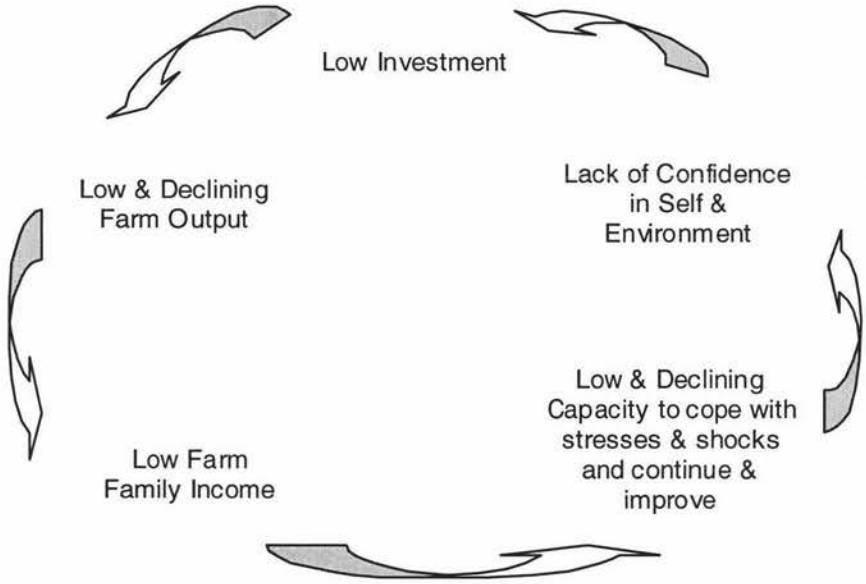

Figure 9.1: The vicious cycle of unsustainability.

The primary goal of most farm families is to offer improved livelihood opportunities to their children. Sixty-six percent of farmers surveyed selected the example "livelihood improvement" goal as their primary objective (refer to Section 8.1.2). If improving their own livelihood and the livelihood opportunities for their children are in fact the primary goals for most of the farmers in the study area, then there is likely to be considerable dissatisfaction with existing farmer livelihoods. This dissatisfaction occurs because the outcome of their current farm systems is a deteriorating and unsustainable livelihood.

9.2.1 Low and declining farm output

The current pastoral sub-systems operated by farmers at Bei Da Ying are environmentally unsustainable. The main cause of this unsustainability is the large transfer of nutrients from the pastoral area to the cropping area that occurs because the livestock are housed at night and the resulting animal waste is transferred directly to the cropping land. These nutrient losses are not currently replaced by fertiliser applied to the pastoral areas (Section 8.2.6) or by rotating the cropped area around the pastoral area, a practice that would eventually see nutrients cycled around the whole farm equitably. Either of these practices, or preferably a combination of the two which would enable micronutrient cycling also, would ensure that the soil nutrient status of the pastoral areas did not decline over time. The estimated annual macronutrient losses from a typical pastoral area in the study area are 33 kg N/ha, 12.4 kg P/ha and 35 kg K/ha (Section 8.2.6).

This large loss of nutrients from the pastoral area has resulted in low and declining pasture yields, in turn leading to reduced carrying capacity and eventually a lower stocking rate. Stocking rate can often be maintained for several years by accepting lower animal performance, over-grazing pastures, and feeding more forage crops and grain to livestock. Lower stocking rates and lower animal performance are reflected in lower farmer incomes.

Figure 9.2 shows the effects on income of these nutrient transfers and the lack of pastoral fertiliser application. The only inputs to the pastoral sub-system are some maize, vetch, turnips and other crop residues as forages for livestock during the dry season. Meanwhile the pastoral sub-system outputs are far greater, with large quantities of nutrients transferred annually, and the sale of livestock and wool. Lost soil nutrients are not being replaced by fertiliser. Thus, income is declining because the maintenance requirements of the pastoral sub-system are not being met, and investments in farm development are not being made to lift output (Section 8.2.8).

As described in Section 8.4.1, many farmers perceive an external locus of control with respect to outcomes on their farms, particularly at the strategic and tactical level, perceiving they have a greater influence over operational aspects of their farm. This perception is related to farm performance in the study area as measured by lambing percentage (see Figure 8.16). Other researchers (e.g., Kaine et al., 1994; Tanewski et al., 2000) also found similar relationships in their studies of farmers in Australia (Section 2.3.2).

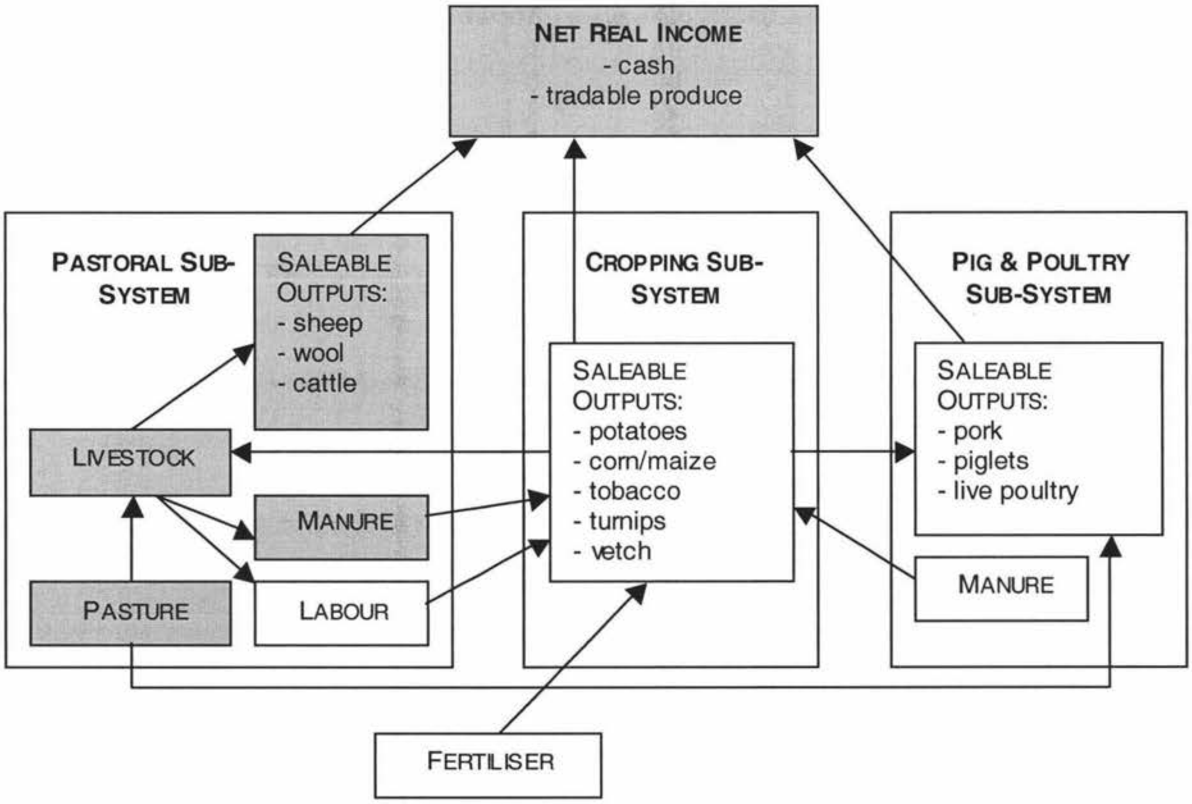

Figure 9.2: Current farm production system showing the flow of energy and nutrients between the three sub-systems to yield saleable or consumable outputs. The shaded boxes are those system components for which output is perceived to be in decline.

Associated with this perception of an external locus of control, is the limited awareness and knowledge of new technologies that many of the farmers in the study area have. Without this awareness, farmers are unable to adopt these technologies and benefit from them (Section 3.2), but instead continue to manage their systems in unsustainable ways. Lack of awareness and knowledge is only part of the adoption of technologies issue — as discussed in Chapter 3, lack of confidence in returns on investment is resulting in many technology-aware farmers being non-adopters (Arnon, 1989).

Physical constraints, such as the difficult and highly seasonal climate, the lack of water on individual farms, the low base soil fertility, the lack of security for grazing livestock and the controls over land use, are also key drivers of the low farm output (Section 8.4).

9.2.2 Low farm family income

Farm family net income is a function of physical output and the price received for that output, less operating expenditure. Therefore, low farm family net income is the result of low output, low price or a combination of both. Low net income can also result from excessively high operating expenditure, but this is not the situation for farmers in the study area (Section 8.4.7).

Typical farm output is low, and is produced inefficiently. Current stocking rates on most farms in the study area are about 4 su/ha, while double this stocking rate has been demonstrated to be physically feasible (Sections 8.1 and 8.3). Lamb finishing time has also been shortened from 15 months to 8 months with savings of 27% in required metabolisable energy on the demonstration farm (Section 8.3). Low output is also often a function of low input levels and operating expenditure (as discussed in Section 2.4.2 and in Section 9.2.1).

Farmers perceive that the prices they receive for sheep, goats, cattle and wool are low (Section 8.5). However, comparing the farm gate price to retail prices shows that farmers are capturing the largest proportion of value. For example, a 33 kg lamb sold in October for the expected farm gate price of 5.50 RMB/kg liveweight would fetch about 13–14 RMB/kg carcass in the retail wet market. Assuming a carcass yield of 45%, this equates to approximately 12 RMB/kg carcass paid to the farmer, or approximately 90% of the retail market value. The proportion of value claimed by these farmers is very high when compared to for example New Zealand farmers who would typically receive 25–33% of domestic retail value for lamb meat. Further, comparing the two farm gate prices on a price per kg of carcass (Table 9.1) shows that there is very little price disparity, and that relative to New Zealand farmers, farmers in the study area are not receiving low peak season prices.

Table 9.1: Peak season farm gate and domestic retail lamb meat prices in the study area and New Zealand during the study period, 1998–1999.

Location	Farm gate price (RMB/kg CWT)[1]	Domestic retail price (RMB/kg CWT)	% Value Captured
Study area, Qujing Prefecture	12.22	13–14	90%
New Zealand[2]	11.25[3]	34–45	25–33%

[1] Carcass weight is based on 45% carcass yield. [2] The approximate exchange rate during the study period was 4.50 RMB = $1NZ. [3] Source: NZMWBES (2000).

This inter-country comparison of lamb meat prices does not consider many other factors outside the farm gate such as the different costs of labour for processing and the costs of living in the two countries. Accepting the weaknesses of this comparison, it is probably still valid to suggest that farm gate prices in the study area are not low compared to those prices received by other pasture-based farmers. However, the point of the analysis is to support the researcher's belief that low output is a more significant driver of low farmer income than is low product price.

Thus, low farmer income from the pastoral livestock sub-system is caused by low and declining farm output. Income from the cropping sub-system is declining because of lower prices (Section 8.1.3.4).

9.2.3 Low and declining farm family capacity

Low and declining farm family income continually reduces the capability of the farm family to obtain a satisfactory livelihood. Thus, the livelihood is not only environmentally unsustainable, but also financially unsustainable, and, therefore, socially unsustainable because the capacity to withstand external stresses and shocks is reduced. Declining farmer income is also undermining the proactive dimension of social sustainability (Chambers and Conway, 1992), because farmers may lose the belief that they can influence their own livelihood, and the ability to fund investment in children's education is lowered, reducing the opportunities for these children to create new and improved livelihoods for themselves (Section 5.2.1).

Further, development projects such as that within which the researcher was employed, are unsustainable because they provide heavily subsidised inputs (e.g., phosphorous fertiliser and pasture seed), without consideration of other constraints highlighted in the results, such as land tenure, farmer locus of control and markets (Sections 8.4 and 8.5). The pastures that were established deteriorated rapidly, thus, negating any possible long-term return from the investment to farmers. This highlights the limitations of using incentives to encourage adoption. Such incentives or subsidies may encourage more farmers to adopt a given technology such as sowing new pastures, but the quality of the adoption was low and the intended consequences were not achieved.

9.2.4 Lack of confidence

Confidence is derived from trust and control (Das and Teng, 1998). The lack of confidence is due to the lack of real and perceived control over, and the lack of trust in, the operating environment. The lack of trust in the operating environment is caused by the current market structure, the information void and government policy (particularly local government land tenure policy) (Section 8.5). The lack of control over the operating environment is caused by those three constraints, plus infrastructure and farmer locus of control and production knowledge constraints.

9.2.4.1 Lack of control

The lack of control that farmers have over the environment in which they operate is both real and farmer-perceived.

Lack of control over the production-impacting environment, and the strategies and tactical options available to counter changes in this environment, may be real or perceived. The lack of control is real if farmers are not aware of the strategies and tactical options, but is only perceived if farmers are aware of these choices but do not believe that they will work for them.

For example, pasture production is highly seasonal, with average seasonality being placid and clustered (Emery and Trist, 1965), while the actual timing of the beginning and end of the rainy season is placid and random (Emery and Trist, 1965) (Section 2.1.7). The placid and clustered nature of the seasonal cycle means that farmers can develop a farm plan to match average feed demand with average feed supply. However, the placid and random nature of the start and finish of the monsoons requires greater tactical flexibility (Kaine et al., 1994). Many farmers did not feel they had sufficient tactical options to overcome the variation in the timing of the monsoons and had difficulties in ensuring livestock were fully fed (Section 8.5.4). Most farmers understand that the strategies of applying fertiliser and sowing more productive pasture species will allow faster pasture recovery and growth in spring and early summer. This will shorten the key feed deficit period, because these well maintained pastures are able to respond more rapidly to warmth and moisture than low fertility pastures. However, discussions with farmers suggested they doubt they can benefit financially from such a strategy (Section 8.5). Similarly, most farmers are aware of the tactical options available to them for overcoming feed deficits, such as growing vetch, changing the short term stocking rate or feeding maize. Thus, this lack of control is probably a *perceived* lack of control, because generally, the farmers are aware of the options.

This suggests that it is necessary to enhance farmers' beliefs that many more aspects of their farming systems can be controlled than they currently perceive, and that their ability to control these aspects needs to be developed as well.

Another aspect that many farmers do not feel they have control over is the price they receive for their animals (Section 8.5). Forty-four percent of farmers surveyed stated they did not use market information in making decisions because the information available is unreliable and out of date (Section 8.5.4). Dealers dominate livestock markets, leaving farmers as price-takers. This domination is possible because farmers are numerous and of small scale, geographically widespread and remote due to poor transport networks, not organised and without market and consumer information. Also, there are very few dealers visiting each village, and farmers participate in the market very infrequently (Section 8.5.1). Several of these characteristics (e.g., numerous farmers/suppliers, occasional transactions) suggest that market transactions are likely to provide the most efficient co-ordination (e.g., Williamson, 1979), but only for the dealers. This is because dealers have the ability to protect their knowledge base (Gerybadze, 1995); they have the least substitutable resources (Boehlje et al., 1998), namely access to transport, access to an *A-hong*, access to wholesale markets and access to restaurants; and because the farmers are selling a commodity. This ownership of the least substitutable resources provides the dealers with the power to allocate returns (Boehlje et al., 1998), as does the lack of bargaining power held by independent, small-scale farmers. Further, Harrigan (1983) suggested that market co-ordination was most appropriate when an industry is in decline (Section 4.4.1). However, the red meat industry in China is far from being in decline (Rae, 1995; Zhang et al., 1997; Heilig, 1999; ClearThinking.com, 2000) (Section 5.5).

Without timely market information it is very difficult for farmers to produce livestock that meet market specifications. Traditionally, such specifications have changed little, but as eating habits change more rapidly, the rate of change in livestock specification is also likely to increase. Also without information, it is very difficult for farmers to know what market opportunities exist that they may be able to take advantage of.

Even once the livestock are grown, the poor transport network constrains the access to markets, which in turn constrains the potential returns for the livestock and livestock products. Constrained prices are a disincentive to invest in farm development.

The lack of control over and the uncertainty surrounding future land tenure policy implemented at the local level is both a real and a perceived constraint. The constraint is real because there is ample evidence to suggest that local officials are able to cancel leases, currently without fear of retribution from some higher bureaucrat, and to make them shorter than has been decreed by central government (Sections 6.3 and 8.5.2). However, the changes that occurred in 1978 leading to the introduction of the household responsibility system were brought about by the spontaneous, unorganised, leaderless, non-ideological and apolitical action[38] of China's farmers (Zhou, 1996). Unorganised action may have been appropriate at that stage in China's development, but a more organised approach may be more useful in the current environment given the government's focus on eliminating excessive taxes and other burdens on farmers (Chen, 1999), and on removing corrupt officials from positions of power (Section 2.1.8). Perhaps farmers can seize greater control over land policy at the local level by co-operating and standing up against opportunistic village administrations. Thus, it may be that this lack of control is also a perceived lack of control.

The lack of access to finance is a real constraint (CIDA, 1999). It requires a change in banking regulations, and a change in the perception that banks have of farmers (Sections 6.3 and 8.5.3). This constraint needs to be considered when evaluating technologies and may have implications for the way that a technology could be adapted to become more adoptable. For example, because farmers are unable to fund the adoption of a full suite of technologies, the technologies should be

[38] Zhou (1996) contested that if the action had been in anyway organised, led, ideological or political, the leaders would have been eliminated and there would have been a severe clampdown on farmers resulting in no positive change.

introduced and implemented in a step-wise pattern en route to complete package adoption.

9.2.4.2 Lack of trust

Farmers do not trust officials, nor do they trust other supply chain participants, especially livestock dealers. Officials are distrusted because they have a history of changing policies to suit their own agenda or to improve their own situation, examples of which were provided in Section 8.5.2. Farmers also know that village officials do not always follow instructions from higher levels of government, rather, they often set their own policies and place a high tax burden on farmers to raise funds (OECD, 1998; Chen, 1999; OECD, 1999). For example, pastoral leases are supposed to be for 30 years, however, those at Bei Da Ying are only 10 years (Section 8.5.2). Farmers perceive that many officials consider and treat farmers as a source of revenue for their own purposes.

Livestock dealers are not trusted because they tend to provide misleading information to farmers and they fully utilise their market power resulting from more frequent market participation, access to and ownership of the least substitutable resources, and the scale imbalance between farmers and dealers (Section 8.5.1). Farmers perceive that dealers are making a large margin on the animals they purchase from farmers. Analysis of farm gate and retail prices in November (Table 9.1) suggests otherwise. However, the farmers' perceptions may well be correct at other non-peak times during the year or when feed supply is low. Researcher observation suggested that the livestock market in the study area is highly adversarial in nature. Further, participants at each stage within the supply chain, if not purposely competing with each other, at least did not appear to co-operate in any way with respect to transactions with other participants from other stages of the supply chain (e.g., in selling livestock to a dealer). Farmers and dealers alike appear to behave opportunistically.

9.2.5 Lack of investment

This aspect could be split into two distinct issues — maintenance and investment. However, the farmers studied did not tend to distinguish between these two concepts during discussions or interviews. The concept of maintenance fertiliser for example was not well understood by most farmers, or by some technicians, and is often considered to be an investment. The level of investment in the maintenance and development of most Bei Da Ying farms is too low to maintain or lift output.

The lack of investment in *asset maintenance* is largely responsible for the decline in farm output because the physical resources of the pastoral sub-system are being depleted, particularly the soil resource which is the driver of the entire production system. There are other factors, such as grazing management, that are also causing the farm resources to be depleted as described in Chapter 8.

The lack of investment in *farm development*, where investment could, for example, be the adoption of a new management practice or the construction of more subdividing fences, is limiting farm output (Section 8.4.7).

Investments are made on the basis of confidence. Thus, the lack of investment by farmers in their pastoral assets suggests that farmers have little confidence in their ability to earn a satisfactory return on such investments. This lack of confidence stems from farmers either:

- Not trusting other supply chain participants and officials with whom they interact in their operating environment, and/or
- Perceiving they are unable to control aspects of their operating environment.

Thus, the problem causing the low level of farmer investment in asset maintenance and farm development is the lack of farmer confidence, derived from a lack of trust in, and a lack of control over, the operating environment.

9.3 Market opportunities for reversing the vicious cycle

There are many red meat market opportunities in China. However, "the Chinese market" is not one market. There are many diverse segments within the country based upon regional and urban/rural locations and the distribution of wealth is closely related to the place of residence (Section 5.2.2). The vast size of the country and the under-developed transport network places constraints on the access to markets remote from producers (Section 6.3).

As has already been described in Section 8.6.1, care must be taken when trying to assist vulnerable or poor people generate higher incomes by ensuring that a market for their produce really exists, and that the changes encouraged do not lead to the overproduction of unwanted goods. Any party, be it an external NGO looking to help poor farmers, or farmers themselves looking to raise their income, must ask questions about the market they are targeting. Where is the market? What does the market really want? Is the market domestic or international? In the livestock industry there is a considerable lead-time between decisions and outcomes. A wrong choice with respect to enterprise mix, targeted market or product would cost valuable development time as well as causing unnecessary stresses on farmers.

A detailed market survey was beyond the scope of this study, and it is not intended to recommend market opportunities that should be pursued. However, two opportunities that appear to be available to the red meat supply chain are:

- The increasing demand for high quality meat from high-end restaurants and hotels, and
- The increasing demand for cooked/processed meat.

As noted in Section 6.2, Chinese consumers have generally been unfamiliar with the difference in eating attributes of different classes of cattle (AFFCO, 2000), or sheep and goats. However, this is changing in more affluent regions of China where consumers are now demanding high quality meat products (Zhang et al., 1997; ClearThinking.com, 2000). As consumers earn higher incomes, they will tend to eat out more often, and red meats are more widely eaten in restaurants than at home (Sections 8.1.5 and 8.1.6). Thus, the upward trend in red meat consumption reported by Rae (1995) is likely to continue.

As described in Section 8.1, the demand for red meat has traditionally been seasonal, with peak demand concentrated in the cooler months of the year. Demand has also been heavily based on consumer perception of the condition the animals will be in during winter and spring, times when feed supply is low. To overcome this negative consumer perception of red meat, particularly of sheep meat, it may be possible to change the product's characteristics through cooking or processing. This cooking or processing could create a new product that is more readily accepted by consumers, such as is done with beef to manufacture *niu gan ba*, the dried beef (Section 8.1.6). Chu (1997) suggested that because Chinese people love ham, perhaps sheep meat could be cured and smoked to make mutton ham, a product that may be more acceptable to consumers. This further processing would probably need to be done by Muslim butchers to ensure market acceptance of the product (see Sections 8.1.5 and 8.1.6).

9.4 Strategic options for reversing the vicious cycle

Based upon the findings reported in this study, farmer operating margin at Bei Da Ying can be significantly increased from 43 RMB/mu of pasture to 77 RMB/mu pasture by adopting the various technologies used on the Bei Da Ying demonstration farm (see Table 8.10). The higher net income is derived from higher pasture production of 8000 kg DM/ha/year, up from 3600–4100 kg DM/ha/year, allowing stocking rate to double from 4.0 to 8.3 su/ha (see Section 8.3.10). Lamb finishing time has been shortened and requires an estimated 27% less metabolisable energy compared to the typical local system.

These differences in output demonstrate the large potential available to farmers in the study area to lift output and income. Figure 9.3 shows how some of the technologies employed on the Bei Da Ying demonstration farm (Section 8.3) interact to impact on farm output and income, and on farm sustainability, particularly through the provision of more productive and higher quality pastures.

Michael Porter's (Porter, 1985) three broad strategies (i.e., cost leadership, specialisation, and differentiation) were described in Chapter 2. The suggestion from the literature was that, small farmers, such as those in the study area, really have only one strategic option, and that is to control their costs. However, over-rigorous cost controlling, as is occurring at present with farmers not maintaining their productive assets, especially the nutrient status of the soil, or investing in further development to raise output, has limited the current and future earning potential of the studied farm families. As has been discussed in Section 9.2, the reason for the lack of maintenance and investment expenditure is the lack of confidence on the part of farmers that such investments will yield them a financial return due to:

- Uncertainty surrounding land tenure;
- Structure of the markets in which farmers participate;

- Lack of access to markets and market information;
- Lack of access to finance to fund such investments; and
- Perceptions that most farm outcomes are outside of their locus of control (Section 9.2).

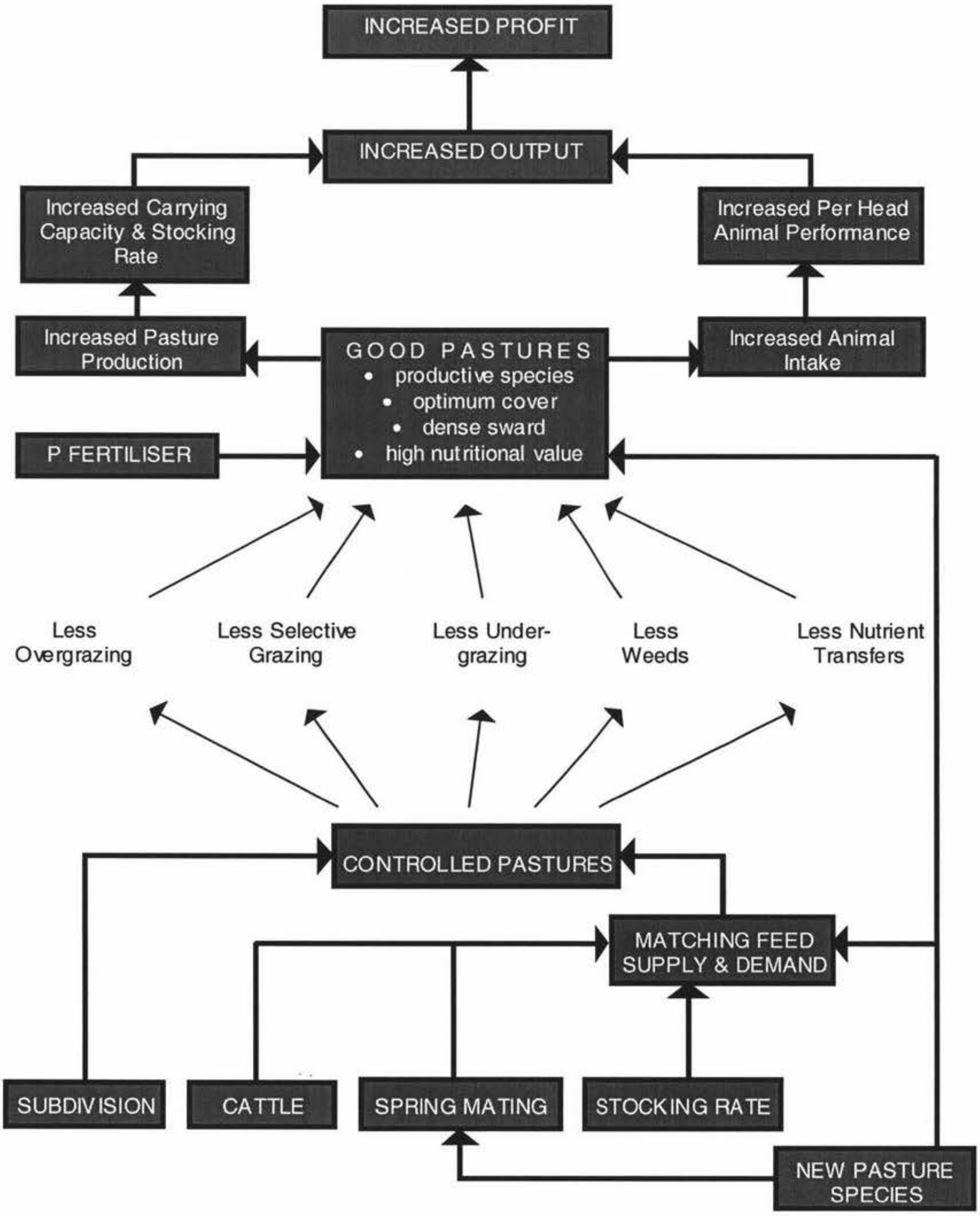

Figure 9.3: The impact of some of the technologies described in this study, and how those effects flow through to higher farm output and farmer net income.

Rather than maintaining or improving the status of their farm and natural resources by investing in risky, long-term technologies; farmers rationally focused their efforts (labour) and spending on their cropping enterprises because returns were much more certain, even though these returns were only short-term. This is because crop returns were received in the immediate year and could not be striped away from farmers by a change in local government policy.

Additionally, the increasing focus on red meat quality (Section 8.1) may initially mean that maintaining the lowest cost of production is irrational, especially for those farm families with access to quality and differentiated product loving market segments. Meat quality is likely to initially be negatively correlated to cost of production. However, as this quality characteristic shifts from being a customer perceived advantage, to being a conformance characteristic (a "given"), cost leadership would again become a driver (Greenan et al., 1997).

Perhaps the other two strategies, specialisation and diversification, in combination with a more moderate approach to cost control, may offer opportunities to farmers in the study area.

9.4.1 Invest in and adopt technologies to raise farm output and improve meat quality

The whole farm system typically consists of three sub-systems: the pastoral sub-system, the cropping sub-system and the pig/poultry sub-system. The pig/poultry sub-system is largely used to provide meat and sometimes eggs for the family's direct consumption. The cropping sub-system provides food for family consumption, livestock feed and some cash income. However, most cash income for the family is sourced from the pastoral sub-system (Section 8.1.4). The three sub-systems have been shown to interact with each other (see Figure 9.2). One of the most significant and troublesome linkages is the flow of soil nutrients from the pastoral sub-system to the cropping sub-system — the problem arising because these transferred nutrients are not replaced.

The current strategy is based upon low cost/input production with virtually no inputs to the pastoral sub-system (i.e., no or very little fertiliser). Crops are grown on flat and high fertility sites and are not rotated around the pastoral areas. Cattle are mainly owned for work. Key components of the current strategy are:

- Some specialist crops (e.g., tobacco) for sale.
- Cropping is a mix of grains, mainly maize/corn, and some turnips for livestock feed — there is heavy reliance on supplements in winter — and food crops, including grain and potatoes for sale and family consumption.
- Manure from sheep/cattle/pigs is used as a crop fertiliser.
- Lambing in autumn and winter – sell lambs at 1 year or older.
- Livestock numbers, especially cattle, are kept low to minimise the winter feed deficit.
- Expenditure, both capital and operational, is kept to a minimum.

This strategy is resulting in low and declining farm output. Also, the quality of the livestock produced is not high. Livestock are not grown and finished as efficiently as they could be (see Table 8.7). Lack of investment in asset maintenance and farm development is one of the primary causes of this low and declining level of farm output. Thus, investing in asset maintenance and farm development must be one of the primary strategies for reversing this downward trend in output and farmer income, as well as being the basis for ensuring the sustainability of future earning capacity and future livelihoods. Such investment could be considered as specialisation (Section 2.4.2). Maintaining a low cost system to optimise profit margin and minimise risk will also be important. Based upon the farm systems research undertaken on the demonstration farms and trial areas, the key components of this strategy would be:

- Sow improved pastures on as much of each farm as possible via crop rotation or traditional pasture-to-pasture cultivation. This will improve pasture production and increase manure output. Applying phosphorous and potassium fertiliser to pasture first and then using the manure for the cropping land effectively uses the fertiliser 'twice'.

- Harvest more pasture by purchasing finishing cattle to provide greater pasture control over the summer growing period. This will enhance crop production via increased manure production.
- Change lambing date to spring once sufficient new pasture has been established is adequate to fully feed lactating ewes in early summer.
- Reduce winter stocking rate to capital stock plus young stock for finishing. Hence, reduce the reliance on supplements that could be sold for human consumption, particularly grains, but place more emphasis on forage crops, particularly legumes such as vetch, and conserved forages (silage/hay).
- Focus on two pasture management objectives for the two main seasons:
  - Maximise net pasture production and pasture quality during summer/autumn (the main growing period); and
  - Maintain winter/spring pastures in best possible condition for rapid recovery and maximum growth in the main growing season.

This investment would mean that pastoral farmers become more intensive, and more focused on producing livestock from their pasture to generate income via increased market participation. Producing food such as potatoes for immediate family consumption would become less important. Farmers may be able to identify one or two specific markets that they can supply with one or two main products. For example, a farmer may decide to produce 30–35 kg lambs for sale in October, as well as 300 kg steers for sale in November, to a specific dealer or restaurant. His cropping land would continue to produce food crops during the summer months, but grow vetch and turnips in the winter to enable better feeding of breeding stock in winter and spring.

Another strategic choice available to farmers is to change the characteristics of the product they sell. Currently farmers are selling live animals. Live animals are a commodity, and are difficult to differentiate and earn a premium over other live animals (Fearne, 1998). One of the reasons it is difficult to differentiate live animals is invisible quality. A buyer cannot be entirely certain that a purchased animal will upon slaughtering and processing have the desired eating attributes. However, it is possible to gain an indication of the likely attributes through observation, but the history and feeding of the animal is unknown to the prospective buyer (Sections 4.2.1 and 4.2.2).

Quality differentiation can be achieved in live animals by producing animals to specification, on time and by being able to prove that best practices have been used to raise the animals. However, the livestock produced under such a strategy, rapidly becomes undifferentiated from the livestock produced by other farmers, as production to specification, on time and using best practices becomes the industry standard, as has occurred in the New Zealand meat industry. The advantage for suppliers pursuing such a strategy is that, although the initial premiums earned for producing quality differentiated livestock will disappear, in the long-term, market share will grow as a result of having produced quality livestock in the long run (Greenan et al., 1997).

Farmers would also need to invest in human resource development in order for them to fully realise the potential of other investments such as new pastures, fertiliser, subdivision or a new ram. Farmers would need to believe they could control the more intensive system, and then learn how to manage and influence the more intensive systems to achieve the desired outcome (Section 2.3.2). Farm extensionists would have a role to play in assisting farmers learn how to use new technologies and better control their farm systems (discussed further in Section 9.5.3).

The nine technologies described in this study have been analysed according to Rogers' (1983) characteristics of innovations framework as outlined in his model of the innovation decision process (Chapter 3). Table 9.2 shows a summary of this analysis.

Table 9.2: Adoptability characteristics of technologies described in this study. A tick (✓) indicates that this characteristic is perceived to be favourably met, while a cross (×) indicates that this characteristic is perceived to not be favourably met.

Technology	Relative Advantage	Observable	Trialable	Not Complex	Compatible
Phosphorous fertiliser	✓	✓	✓	✓	✓
New pasture species	✓ Also requires a change in pasture management	✓	✓	× Requires a lot of planning & changes in pasture management	✓ Reduces grazing area in spring/ early summer
Subdivision/Fencing	✓ Related to intensity of adoption	× Related to intensity of adoption	✓	× Benefits are only realised if other changes are made	× Security, water & feeding of supplements at home
Improved sheep genetics	✓	✓	× Scale - cannot buy part of a ram	✓ Better animals require better feeding	✓ Requires improved sources of feed
Crop/pasture rotation	✓	✓	✓	× Learning about sustainability & nutrient cycling	× Social perceptions & land tenure constraints
Cattle	✓	✓	✓	✓	✓ May require extra housing
Sheep night penning	✓	✓	✓	× Requires alternative source of nutrients for cropping	× Diverting manure away from crops
Grazing management e.g., feed planning, grazing targets	✓	✓	✓	× Learning agronomic principles, Is easier if other changes are also adopted	✓ Is easier if other changes are also adopted
Controlled mating/spring lambing	✓ Only if pastures are improved	✓	✓	× Difficult to adjust mating dates and separate livestock classes	✓ Only if pastures are improved

Phosphorous fertiliser (Section 8.3.1) is a relatively straightforward technology that is compatible to current farm systems, and provides a high return particularly in combination with new pastures. Farmers have observed the fertiliser trials and discussed the likely impact on stocking rates. However, farmers remained uncertain as to the return for them at an unsubsidised price.

New pasture species (Section 8.3.2) require significant planning, especially during establishment, because grazing pressure on the remainder of the farm is very high during the early summer pasture establishment period, a time when feed supply from indigenous pastures is low. To gain the full benefits of establishing new pastures and species, other changes must occur. Grazing management needs to focus on pasture control and target post-grazing pasture covers to minimise over-grazing. Phosphorous fertiliser needs to be applied each year to balance nutrient losses. Cattle may be needed in mid-late summer to control the rapidly growing pasture and maintain quality and future productivity, as would subdivision of new pastures from other pasture types. It is likely that a change in lambing date to spring will also be beneficial, but only as the area of improved pasture sown increases. Thus, the establishment of new pastures is quite a complex change.

Subdivision (Section 8.3.3) is perhaps the most complex and least well understood technology extended by the project. This may explain why even experienced technicians were reluctant to use more intensive subdivision on the demonstration farms they managed. The benefits of subdivision depend upon the degree to which the technology is adopted. The more paddocks a farm is subdivided into, the greater control the manager has over the pasture and the farm's performance. For example, the second paddock fenced is likely to yield a lower return than the tenth paddock fenced. Thus, the greater the extent of adoption, the greater the benefits received and the more observable these benefits are, up to some optimum level of subdivision (probably at about ten paddocks for these small-scale mixed livestock and cropping farms).

Improving the genetics of the sheep (Section 8.3.4) would be inappropriate without improving the pastures, reducing the stocking rate, or by increasing feed allowance in some other way. Sheep with higher potential require higher feeding levels for them to reach that potential. Researcher observation of state breeding farms in Yunnan Province (running introduced cattle and sheep breeds), suggests that improved sheep breeds introduced to the system with the current pastures and feeding regimes would probably perform at a lower level than the current Cormo breed. The easiest way for a farmer to improve the genetics of the flock is to purchase a ram. However, the small scale of farms means farmers would be unable to trial a new ram while retaining the old self-bred ram: two rams for 22 ewes would be unjustifiable (rams would make up 1/12 of the adult flock compared to approximately 1/70 as is common in New Zealand).

The rotation of crops around the pastoral area (Section 8.3.5) is not readily compatible with a farmer's current situation. As noted in the results, farmers were worried that if they changed the use of their designated pastoral land to cropping, even for a short time, they may have their lease terminated. Before adopting this technology, farmers would first need to understand the effect their current practices are having on their pastoral land. Such learning would take time to facilitate, and would be hindered by farmer perception that pasture is not a crop, that cropping land is cropping land and that pastoral land is pastoral land.

Increasing the number of cattle (Section 8.3.6) is perceived to be a relatively straightforward technology. Objective researcher experience is that cattle do not compete with sheep in pastoral systems in Southwest China during the targeted summer/autumn period. Benefits are readily observed, and even allowing for the small scale of farms, increasing cattle numbers can be tried incrementally. The lack of adequate housing for more cattle may be a factor influencing the compatibility of this technology.

Sheep night penning (Section 8.3.7) diverts valuable manure away from the cropping sub-system, making the technology at least partially incompatible with the existing system, and seen by farmers as a cost of the technology. Other problems exist, such as foot rot caused by standing for long periods on wet and muddy ground, which also makes the technique inappropriate for goats. Farmers must also have ready access to good temporary fence material in order to confine the sheep. However, sheep night penning is a low cost means of establishing new pastures and returns nutrients to pastoral areas. Night penning is of particular value on land that cannot be readily cultivated because of soil or farmer resource constraints.

Grazing management (Section 8.3.8) is central to many of the other technologies described but is in itself a complex "technology". Grazing management is made easier if other technologies such as subdivision and increased cattle numbers are also adopted. Grazing management is critical to realising benefits from the package of technologies implemented on the Bei Da Ying demonstration farm. For farmers to utilise such techniques as post-grazing pasture cover targets, they must first have an understanding of the principles behind such practices. The learning required to gain this understanding is complex and takes time to extend, as New Zealand pastoral farming principles are quite different to those employed by farmers in the study area.

Controlled mating and spring lambing (Section 8.3.9) will provide a benefit only if pastures have been improved sufficiently for there to be sufficient pasture growth in spring/early summer to meet lactating ewe feed demands. Currently, the deteriorated pastures dominating farms in the study area are inadequate for the feeding of spring lambing ewes. The researcher feels that before a change is made in lambing date, higher yielding pastures and pastures that recover rapidly after the winter and spring dry period are necessary over at least one third of the farm. Without such pastures, ewes will lamb onto very low pasture covers affecting lamb survival and subsequent pasture and animal performance. Alternatively, if lambing is postponed until late spring/summer when indigenous pasture growth rate is lifting the lambs will not reach saleable weights before the winter and will require carrying over into the second year. Both situations would probably result in worse performance than is achieved by existing autumn lambing systems. Hence, this technology should not be extended until pasture production constraints have been overcome.

9.4.2 Further process to add value to livestock products

For farmers to be able to differentiate their products to the extent where premiums are sustainable, further processing of livestock products is essential. Differentiating at the live animal level is unlikely to offer long-term benefits to farmers, because other farmers can soon replicate product characteristics and shift perceived quality characteristics to being conformance characteristics. However, quality differentiation at the live animal stage is an essential first step because consumers throughout China are increasingly demanding quality food products (Zhang et al., 1997; ClearThinking.com, 2000) (Section 6.3). Food quality is not limited to taste and appearance, but also to the healthiness of the product (Rae, 1995), and may eventually encompass issues such as production methods and environmental sustainability (Section 2.1.3). New quality characteristics are perceived by customers to be important, and older quality characteristics become specifications that must be met at the lowest cost. The faster that farmers adopt farm management practices allowing these conformance specifications to be met, the more experience with these practices they will have. Therefore, the farmers will have a greater understanding of these practices, and be able to implement them at a lower cost, maintaining cost leadership, and thereby market share and a satisfying livelihood.

There are two possible approaches to differentiation for farmers in the study area. One is to continually innovate and develop new products to try and keep ahead of the competition. The second is to develop a product for which the critical resources (knowledge) can readily be protected from competitors. A combination of both approaches to produce a mainstay product (e.g., vacuum-packed mutton ham), with several other lesser products (e.g., garlic or spicy sausages), may provide the greatest certainty of market share and leadership.

Farmers might choose to invest in, and undertake, further processing themselves. However, because they currently lack the skills and resources to process livestock, a more appropriate strategy may be to enter into co-operative relationships with people who do have the skills and resources to undertake such processing. Further, the farmers individually lack the scale to enable regular supply of livestock. Buying animals from neighbouring farmers would offer such a supply, but would do little for community relationships. A more preferable approach may be to co-operate with other farmers to meet supply requirements.

9.4.3 Co-operation

The current red meat supply chain is perceived by the researcher to be relatively unmanaged, relying upon Adam Smith's "Invisible Hand" to achieve supply chain co-ordination, rather than being a more actively managed value chain.

Figure 9.4 shows a typical, generic, red meat supply chain for the study area with independent participants. The inherent instability and uncertainty at each transaction interface is shown. There is little sharing of information or consideration of mutual interests, as relationships, particularly between participants to the left of the supply chain, are of a short-term nature based on market transactions with participants actively seeking to be opportunistic. Thus, the supply chain is dominated by adversarial relationships between chain participants, and the risks for each participant are significant (Sections 4.4.1 and 4.4.2).

Emery and Trist (1965) suggested that the preferred strategy for managing an unpredictable environment is to change the causal structure of that environment. The relationships between many supply chain participants could be described as being turbulent because of the unreliable, ambiguous and misleading information flows. Kaine et al. (1994) suggested that for such turbulent fields, greater predictability could be created by establishing a set of values shared by all members of the environment. Co-operation between supply chain participants is central to the establishment of such a value set, and the creation of greater predictability. Less uncertainty will increase the confidence of each supply chain participant, especially farmers, which will encourage increased levels of investment. Such investment can be directed at raising output, quality differentiation and meeting market opportunities.

The relationships of critical importance to farmers are with extensionists, suppliers, bankers, processors and potentially the retail sector. The livestock dealer could be made redundant if farmers were to co-operate horizontally to sell their livestock directly in sufficient numbers to processors or retailers — the scale imbalance between farmers and other supply chain participants has already been noted above.

Each supply chain participant will eventually appreciate that to supply what the customer wants is the key to long-term profitability and improved livelihoods. Co-operation is the strategic means of reducing the uncertainty inherent in specific investments, of gaining leverage over access, capabilities and assets, and to better meet the demands of consumers (Section 4.3.1).

The difficulty in such an approach is in finding an extension agent, a financial institution and an input supplier to co-operate with. These activities are dominated by the public sector. Co-operation between these participants has not readily occurred previously, and is unlikely to be readily undertaken by either side. Further, dealers and restaurateurs tend to behave opportunistically as discussed above.

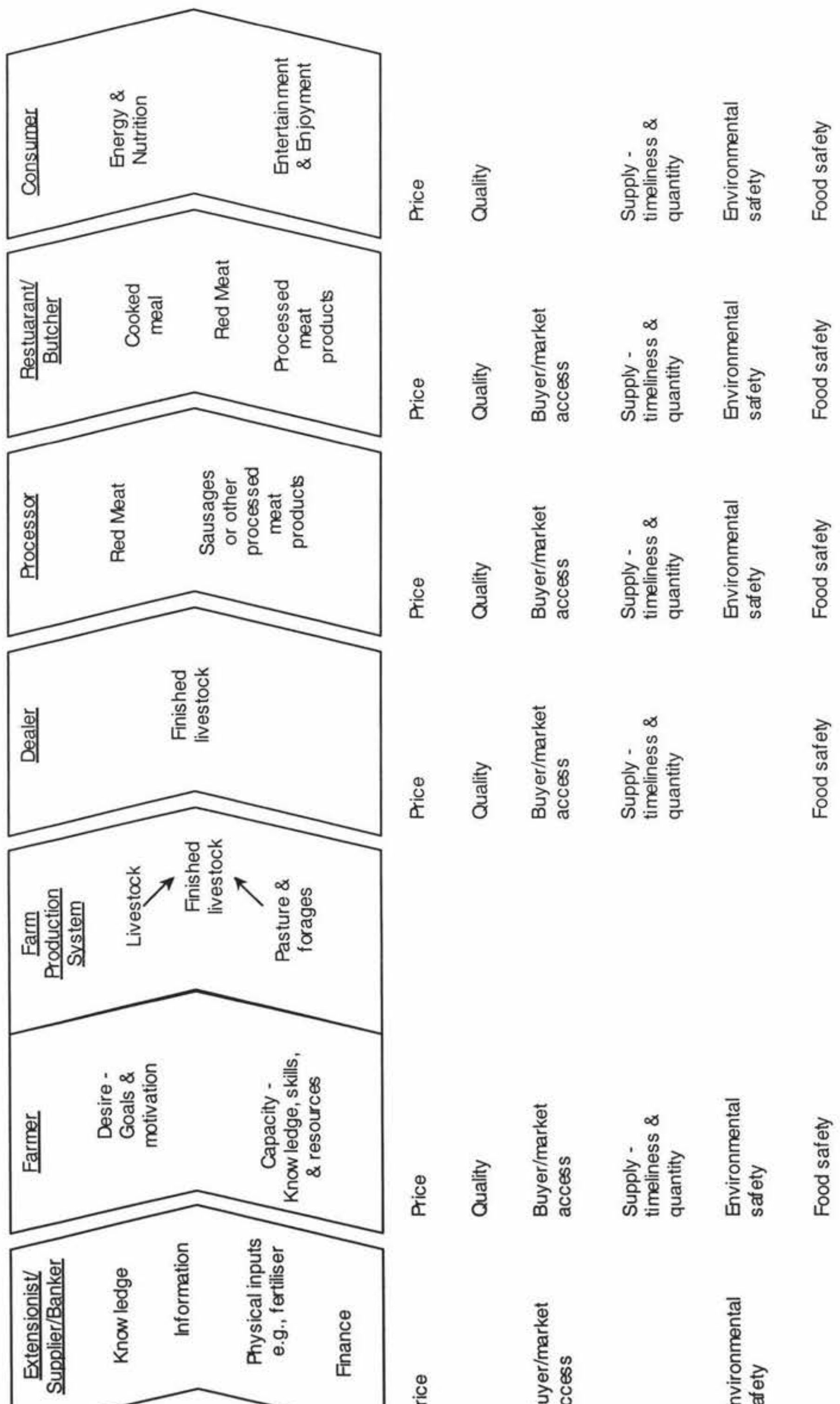

Figure 9.4: Generic supply chain for the production of red meat typical of the study area with the risks for each of the six participants listed below. The researcher believes that the "reverse flow" of information is not strong, and therefore, is not shown here.

Farmers have several options for managing these transactions. One choice is to co-operate vertically with participants at different stages along the supply chain (Section 4.1.2). A second choice is to internalise these transactions through backward and/or forward vertical integration (Section 4.1.3). A third choice, related to the first choice, is to involve an integrated agribusiness that is prepared to supply inputs, an extension service, finance and a market for the finished livestock or meat (Section 4.1.2). Thailand's CP Group offers numerous examples in developing nations where this approach has successfully developed rural communities and established sustainable livelihoods and opportunities while still achieving corporate profitability (Karen, 1985).

In discussions with farmers, co-operation was suggested by the researcher as a means to overcoming many of the problems facing farmers. Farmers agreed that the idea was valid, and did offer many advantages, but expressed reservations largely due to recent collective farming experiences. Farmers were nervous that such co-operation would be managed by the state, and that the outcome would be little different to the system effectively overthrown by farmers in 1978. Therefore, the state should not play a major role in organising farmer co-operation either between farmers, or between farmers and other supply chain participants. Rather, the state's role is to ensure the creation of the enabling environment so that individuals and families are able to establish sustainable livelihoods and improve their situation (Section 5.4.2).

Both the differentiation and specialisation strategies require specific investments (Williamson, 1979; 1991). For example, if a farmer decides to specialise in intensive pastoral livestock production for the supply of animals to specification, on time, using best practices to a certain dealer, the investment in fencing, new pastures and new rams is relatively specific to that transaction because the farmer may not be able to obtain the same return from another dealer should the original buyer decide not to purchase the animals (O'Keefe, 1998b). Differentiation, specialisation and the associated specific investments involve increased risk and exposure to opportunistic behaviour from customers and from officials (Williamson, 1979). Minimising risk was considered to be a relatively important goal by most farm families (Section 8.1.2). For farmers to make these risky investments, there would need to be an increase in farmer confidence, which requires greater trust, and a greater amount of sharing of quality information, as well as a shift in the control structure (Section 4.4.1).

One of the reasons why farmers currently lack market power is the lack of farmer scale. Horizontal co-operation (see Section 4.1.2) between farmers could provide bargaining strength, economies of scale and a reduction in market uncertainty (Fearne, 1998; Rebelo et al., 1998). For a single small farmer to undertake intensification and then attempt to differentiate his livestock, the risks would be high, as a buyer is unlikely to want to pay a premium. A rational dealer would not pay a premium because they still control the market and the flow of information while the farmer would only be offering a small number of animals. The dealer is likely to consider the farmer as "just one more unimportant supplier". Similarly, assuming a single farmer had the financial resources to try to further process animals into, for example, cooked meat products, the risks would be high because he has no reputation as a butcher, has no meat seller's license, and would be unlikely to be able to participate in the market regularly due to lack of animal supply. Horizontal co-operation is a strategy that could offer farmers the scale to take a supply contract to a buyer or restaurant that is feasible to both the group of sellers and the prospective buyer. Further, a trading co-operative could be used by farmers to manage the transactions for physical inputs such as fertiliser and pasture seed, but would not readily allow farmers to manage the transactions for knowledge and technology inputs. Fertiliser may be able to be purchased at a lower cost because of the larger volume purchased. Though costs may be reduced, value is not being created. Farmer value prior to the farm system is created by both technology and knowledge — the value of fertiliser is only realised by efficiently utilising the extra pasture grown. Also, horizontal co-operation could offer farmers the necessary volume of supply and financial capital for them to start their own further processing plant in a way similar to co-operatives in New Zealand's dairy industry (Section 4.1.2).

Vertical co-operation could provide farmers with more certainty with respect to access to markets and capabilities, and to price (Section 4.3.1). Farmers could form a co-operative that contracts an existing processor or A-hong to slaughter livestock and process the carcasses to specification. The farmer co-operative could then market the meat directly to restaurants or meat retailers in order to capture greater value (Section 4.1.2). This co-operative would negate the need to sell livestock to a dealer who provides unreliable, untimely and ambiguous market information. One of the major challenges for such a farmer co-operative would be sourcing sufficient livestock that are ready for sale throughout the key periods of demand.

The lack of access to finance has already been highlighted (Section 7.5.3), and the assumption for the strategies outlined in this study is that such constraints are mitigated by the state. Even with access to finance at fair market rates, it is unlikely that farmers would be able to fund the expenditure necessary to establish, for example, a processing plant, because they will need to employ available liquid assets to fund much-needed on-farm development (Section 8.5.1). It may be possible to seek non-farming investors to provide equity to such ventures, but the researcher doubts farmers would favour this approach because there are no existing relationships between farmers and any potential financers. The absence of trust is a significant barrier, and control would be difficult to achieve for farmers (Section 4.4.1).

9.5 Means of sustainable development

Farmers must be empowered for them to be able to realise improved livelihoods and implement the suggested strategic choices for development (Section 9.4). For farmers to be empowered, three critical factors have been identified:

(i) Change in farmer perception of control with respect to their farm environments;

(ii) Greater sharing of control between participants within and supporting the supply chain; and

(iii) Farmers learning about farm production systems, and both farmers and other supply chain participants (e.g., extension workers, livestock dealers and restaurants) learning about each other.

9.5.1 Changes in farmer perception of control

Farmers displayed a significant belief in an external locus of control, especially with respect to strategic and tactical aspects, perceiving that they only have some influence over events and outcomes that impact on their livelihoods. Farmers appear to perceive a lack of control over their farm systems, the markets in which they participate, and their future (Sections 8.4.1 and 8.5.4). Farmers and their families can, in fact, influence some of these aspects. What farmers require is the belief or perception that these aspects can be controlled, and the knowledge of how to control them.

Believing that one can influence events and outcomes that genuinely can be influenced (e.g., the balance between pasture supply and pasture demand) is positively correlated to the goals that the individual sets, the strategies employed to achieve those goals, and ultimately the attainment of those goals (Section 2.3.2). Perception is a result of learning, experience, knowledge and judgement (Kaine et al., 1994). Experience is past and cannot be changed by the intervention of outsiders, although the future experiences can be influenced by outsiders, just as past experiences have been. Judgement is a psychological factor that also intervention cannot change. However, learning and knowledge can be influenced by an outsider's intervention (Section 3.4).

In Section 8.5.4, farmer loci of control and technician perception of farmer loci of control were reported. There were some similarities between farmer and technician perceptions. For example, Question 9, the only question to which more farmers responded with an external locus of control than with an internal locus of control was also responded to similarly by three out of eight technicians.

> *I generally find that even though climatic conditions change from year to year, I can still make improvements to both my cropping and pastoral systems' performance. [Internal locus of control].*
>
> *For a farm like mine, it is very difficult to make improvements because the seasonal conditions vary so much between years. [External locus of control].*

Such responses illustrate the lack of control farmers (and some technicians) perceive farmers have over their operating environments. Accepting that seasonal conditions are quite variable, it is still possible to make improvements to farm performance, as was demonstrated on the Bei Da Ying demonstration farm. These technicians are either accurate in their assessment that farmers perceive they cannot control much of their farm system's outcome, and incorrectly believe that these farmers are also unable to exercise control because they are lazy and stupid (see Section 8.1.2), or the technicians themselves do not believe that such outcomes can be influenced. Either way, some technicians have learning to do themselves because (a) farmers are not lazy and stupid and (b) many events can be managed, or at least influenced by farmers, to provide more favourable outcomes. Many farmers and perhaps some technicians also lack the knowledge to be able to influence farm system' outcomes. However, most technicians surveyed, perceived that they or farmers are able to, or should be able to, control most aspects of a farm business. Many technicians also have a negative perception of farmers' abilities to learn and work (Section 8.1.2).

To encourage changes in farmer perception of control, outsiders can intervene by providing knowledge, offering learning opportunities, and giving opportunities to gain experience with technologies and management practices. Outsiders can also assist in the creation of an enabling environment, and for many of the environmental constraints affecting farmers in the study area, outsiders must be responsible for making changes and ensuring more equal access to resources and opportunities (Sections 5.3.1 and 5.4.2). This aspect is about sharing control between participants within and supporting the supply chain.

9.5.2 Shared control

Shared control is about creating an enabling environment in which all individuals have an equal access to resources and opportunities, and about reducing the amount of uncertainty in the operating environment. Currently, farmers face considerable uncertainty that exists for no purpose except to enable greater levels of opportunity to those few who dominate the operating environment, such as village administration officials and livestock dealers. Farmers have little flexibility in the systems they operate, but significant changes can be imposed at short notice. Farmers are starved of information, and have restricted access to markets, finance and other inputs (Section 6.3).

The creation of a more certain operating environment requires more than a sharing of control, but also the establishment of relationships and trust between supply chain participants, both horizontally and vertically. Increased certainty in the operating environment is likely to lead to higher farmer confidence, and then investment in their production system. Such investment is essential for growth in all parts of the supply chain — if farmers are unable to produce quality livestock, then meat will always remain a commodity product, and the value of the product will remain the same. The margins for each supply chain participant are limited by the final value of the product, which will be low (Section 4.2). Thus, all participants will continue to receive low returns.

Key changes that need to occur to allow a more equal sharing of control and the establishment of more trusting relationships in an enabling environment are:

(i) Longer pastoral leases that are guaranteed to be of the specified term without changes in lease conditions (requires more stringent enforcement of state law);

(ii) Village and county officials removing uncertainty over taxation, and improving security of livestock and property;

(iii) A relaxing of land use controls so that farmers can make their own decisions as to the most economic and sustainable use of land, although this would probably need to be within some guidelines;

(iv) Access to credit markets for farmers either individually or co-operatively via relaxation of financial regulations; and

(v) Improved road and transport networks allowing farmers to more readily participate in markets to which they are currently remote. This would also allow farmers more timely access to market and accurate price information (because of the direct contact with customers such as restaurateurs and butchers rather than livestock dealers who, according to farmers, are providing misleading information).

9.5.3 Learning

Many problems have been highlighted with the current pastoral farm production systems in the study area (Section 8.2), the most significant being pasture degradation and the loss of soil nutrients. Commodity products are being produced without detailed consideration of the market situation (Section 8.6.1). Production cycles for sheep meat and beef are long. Farmers do not possess much of the knowledge base and understanding essential for overcoming these production and market problems (Section 8.4.1).

Because outsiders can influence learning and knowledge, there may be a role for intervention to extend and facilitate understanding of the underlying causes and concepts relating to these problems. Extension could assist farming families establish sustainable livelihoods for themselves, and to increase their integration with the wider economy. The primary role of extensionists should be to assist farmers improve their production systems with particular emphasis on raising output, efficiency, and both environmental and financial sustainability. The currently favoured methods for development intervention revolve around farmer participation and outsider facilitation, with the farmers developing their own technologies (e.g., Chambers, 1994) (Section 3.4). However, the characteristics of agricultural or food products are decreasingly dictated by producers — or in this case, the state — and increasingly determined by consumer preferences (Section 4.3.2). The producer in many markets no longer solely determines even the practices used to produce these goods. Rather, production practices are largely controlled by consumer preferences and the resulting regulations and technologies, or the processor may specify practices based on consumer preferences (see Chapter 4).

Further, many of the technologies and management practices required to make the desired improvements to small mixed farming systems have already been widely experimented with and tested in many situations inside China (Section 6.4). Therefore, there may be a role, at least initially, for traditional transfer of technology, provided that the effort is made to ensure that the technologies extended are appropriate and will have a positive impact for farm families. This is not an assumption that successful development and change will result from the transfer of technology and ideas from a New Zealand context, but rather that it seems appropriate to utilise and build upon the experience and knowledge that already exists. To date, adoption of these technologies and practices by farmers has been low because:

(i) Technologies and practices developed and extended have not always been appropriate for the situation in which they were attempted to be placed (see Table 9.2 and the discussion that followed);

(ii) Farmers have perceived an external locus of control for many aspects of their farming enterprises;

(iii) Technologies and practices have not been widely extended; and

(iv) Operating environment and farmer situation have not favoured or encouraged such adoption and investment, effectively rendering such innovations inappropriate and too risky.

As highlighted in Section 6.6 and in the results, many livestock and pasture extensionists dislike and neglect fieldwork, because of the low salary and the desire to avoid responsibility and difficult conditions. However, paying higher salaries to many of the existing technicians will be unlikely to overcome this problem. The solution is more likely to come with a new generation of extension workers who want to help their home village residents become wealthier[39].

Extension workers need to change their attitudes if they are to contribute to farmer learning and development. The first step in achieving change is to build trust between extensionists and farmers. This trust would be built upon the extensionist's preparedness to spend time in the field; the extensionist's preparedness to listen and learn from farmers; the extensionist's understanding of the situation and production system; and the extensionist having something of value to offer the farmers. This last point is of primary importance, as without something of value on offer, farmers have no reason to listen to or engage with the extensionist.

Trust and credibility can be built initially with the extensionist providing access to information on technologies that can be readily adopted, providing observable results, or perhaps by arranging for farm inputs to be delivered from the county. At the same

[39] The researcher worked on several CARE International development projects in Guanxi Province after the UNV posting. The most conscientious field staff were those who came from local villages and had the chance to gain an education and then wanted to return something to their home villages.

time, small demonstrations such as fertiliser trials can be established to start raising farmer awareness and interest (Section 3.4). Fertiliser trials are often appropriate because most farmers are aware that soil fertility is a constraint, but do not perceive that overcoming the constraint with fertiliser provides an adequate return (Section 8.2.5). Farmers must be involved early so they understand what inputs are being used and will therefore believe the results. Farmers in the study area initially claimed that the GGERI/AHB project research was not reflective of their situation, because the project was perceived by farmers to have had access to unlimited resources.

Over time, through discussion and observation, farmers will become aware of and be able to evaluate the demonstrated technologies, and will make a decision to adopt/not adopt the innovation based on their own analysis, perception and intuition (Section 3.1.2). It may be that some farmers will want to become demonstration households, a technique that is supposedly central to, but actually uncommon in China's existing extension system (Section 6.6). Farmer ownership of demonstrations is perceived to be important by the researcher and several of the technicians who were involved in the GGERI/AHB project. If the demonstration farm is owned and managed by a genuinely commercial farmer, then other farmers can observe and determine the advantages and costs, the complexity and the compatibility to their own, similar system (Section 3.2.3).

The learning that farmers and outsiders are able to achieve together will lead to a change in perception of what aspects of the business and production system can be controlled or managed to provide greater certainty. By jointly identifying barriers to and catalysts of change, it should then be possible to work together to eliminate those barriers and promote the catalysts to facilitate the transformation of their local communities.

10 Conclusion

10.1 Revised methodology

If the researcher had his time again he would focus more narrowly on a single issue rather than the broad analysis of the constraints and opportunities to improving farm family income from red meat. However, an exploratory case study approach still be employed. Based on the findings of the research reported, two areas that offer opportunities for future research and are much narrower in scope than this thesis are:

(i) An evaluation of the appropriateness and adoptability of technologies extended as part of the development project (e.g., crop rotation, phosphorous fertilizer and subdivision) and the process of identifying and developing suitable technologies for adoption to meet farm family goals. This could involve understanding the barriers to adoption, getting an accurate quantification of the impact of each technology on their own (experimental) and within a wider farm system, and then proposing guidelines for an extension and technology development strategy.

(ii) Determining the benefits (if any) to farm families of vertical and horizontal co-operation and how these benefits might be realised. This could involve looking at the barriers to co-operation from farmer, dealer and restaurateur perspectives; quantifying the impacts on each participant along the value chain and the whole value chain itself, and then proposing guidelines for encouraging increased co-operation between participants in the value chain should that prove beneficial.

Undertaking research in a developing country while working is difficult and very challenging because of the need to balance solving problems with maintaining the quality and focus of research, the remoteness from supervisors and peers and the operating environment. Notwithstanding these challenges, such an approach can be very rewarding for the researcher because of the opportunities to learn and develop as an individual, and should offer similar opportunities for project participants. Based upon the experience the researcher gained in undertaking this study and the lessons learnt (reported in Section 9.1), a revised methodology is proposed in the following paragraphs as a guideline for future studies of this nature.

It is preferable to have learnt the language prior to entering the field, at least to a level at which a conversation can be held. Technical language is less important as it will be readily picked up in country. An interpreter will still be necessary at least initially – they will also help avoid cultural faux pars. Language proficiency will also mean that interviews could be audio-recorded.

Define the broad subject area for research and undertake a literature review to establish general understanding. It is also necessary to develop skills in Rapid Rural Appraisal (RRA) and to gain an understanding of potential research methods.

Once the subject area is defined and literature review completed, a short initiation period in the field may be beneficial. The purpose of this first set of fieldwork is to build rapport with the project team and participants; identify key issues using an RRA approach; overcome the novelty factor and excitement; become familiar with the new context and environment; determine case parameters; define the role of the researcher and gain mutual understanding as to the purpose of the researcher's study; and visit potential case study villages/sites. This visit may require up to one month to complete these tasks.

Once back in the home country the researcher will need to reflect on the research conditions, suitability of the posting for doing research and observations so far. These reflections should be recorded and reported in the final research report. Then it is necessary to focus on one tightly defined aspect and formulate the research question or proposition. Data requirements should then be considered and a framework for the case study report drafted. A thorough review of the research methods literature (qualitative and quantitative) will assist determine the most appropriate methods, sources and design to elicit the required information. A case study protocol should then be written and objectives and milestones specified. Any experiments should also be designed. A case study database should be developed to provide a structured means of managing data as it is collected and collated. It may also be possible to select cases to be studied. Any further subject literature review should also be completed before returning to the field for the main data collection.

Upon returning to the field, the research design needs to be reviewed with project management to gain their sign-off and to assist with case study selection if not already completed (case study selection will often be politically motivated, so gaining agreement from project managers and local officials is essential). Multiple cases should be used to increase external validity. Data collection can then occur in association with normal work/project duties – it is important to budget in research and observation time to maintain momentum and focus because it is easy to become "too" involved in the project and its problems. Descriptive and comprehensive field notes should be kept and a verbal review should be carried out during each interview with key informants to check for understanding. Case study records should be written as soon after each interview as possible. Multiple sources of information and types of data should be collected to enable triangulation of data and increase construct validity. The case study narrative or report can also be written in the field.

Data can be analysed either in the field or in the home country. Research findings can then be reported and the cross-case analyses completed. Several key informants (probably project team members) should review the study to check accuracy of the results and inferences made in the research. Conclusions can then be drawn and theory developed.

10.2 Turning the vicious cycle of unsustainability around

Many of the farm families at Bei Da Ying are not in a position where they can progress towards their main goal of providing improved livelihood opportunities for the family. This inability to grow the family's capacity is just one link in a vicious cycle of unsustainability (Figure 9.1). Farm families are generating low incomes from their mixed cropping and pastoral livestock enterprises, and this income is likely to decline further as pastoral and livestock productivity continues to fall. The low and declining level of farm productivity is due to degradation of soils and pastures, eroding the future earning capacity of these natural resources. These assets are being destroyed because farmers are often unable to (due to financial constraints) or have decided against investing or maintaining the potential of the soil and pasture. The decision to not invest or maintain resources is the result of a complete lack of confidence in the security of their futures and the return they might earn on such investments. This lack of investment is due to a real and perceived lack of control that farmers and their families can exercise over their operating environment and a lack of trust in other supply chain participants and officials.

However, the expansion in demand for red meat (particularly high quality beef) by urban residents offers an opportunity for mixed cropping and pastoral farmers to increase their income. This demand for red meat is driven by rising incomes. With higher incomes people tend to eat out more often, and red meats are more widely eaten in restaurants than at home. Red meat consumption has traditionally been concentrated in the winter months. This has contributed to the negative perception many consumers have of red meat because they believe that livestock will be in poor condition during this period due to the dry and cold weather limiting feed availability. These perceptions may need to be overcome to realise this opportunity. Further processing meat or cooking/smoking the meat may be a means to achieving this change.

To reverse the vicious cycle of unsustainability and take advantage of the developing market opportunities, three strategic options have been identified and discussed for farm families like those at Bei Da Ying. These options are:

(i) Invest in, adopt and develop technologies to raise farm output and meat quality;

(ii) Further process meat to add value and increase consumer acceptance; and

(iii) Co-operation to build stronger relationships between farmers and other supply chain participants, including other farmers.

The objective of the development project the researcher worked on was to extend and transfer "proven New Zealand technologies" to farmers in Yunnan to increase their farm output. As part of the project various technologies were trialled, demonstrated and adapted to local conditions. The combined benefits of these technologies on the demonstration farm at Bei Da Ying were to double pasture production and stocking rate, increase the efficiency of animal liveweight gain and almost double the operating margin. Such changes, if adopted and successfully implemented on farms like those at Bei Da Ying, could assist farm families reverse the cycle of unsustainability. However, there are four broad constraints that have inhibited most farm families from adopting these technologies:

(i) Technologies and practices developed and extended have not always considered the physical and financial constraints faced by farmers;

(ii) Farmers have perceived an external locus of control for many aspects of their farming enterprises;

(iii) Technologies and practices have not been widely extended; and

(iv) Market structure, uncertainty, insecurity, resource access and farmer situation have not favoured or encouraged such adoption and investment, effectively rendering such innovations inappropriate and too risky.

These same constraints would similarly limit farm families' ability to further process or add value to livestock products, and until some of these constraints are removed it would be extremely difficult for closer relationships to be developed.

Before farm families can implement any of the strategic options successfully, i.e., to provide improved livelihoods, farmers and their families must be empowered. Farmer empowerment requires a change in farmer perception of control; greater sharing of control; and farmers and other supply chain participants learning about production systems and about each other.

Farmers currently perceive that they can control most operational aspects of their systems, but perceive they are less able to control most tactical and strategic aspects. Such an external locus of control is one of the key drivers of the low performance achieved by the farmers. Outsiders can encourage changes in farmer perceptions by providing knowledge, offering learning opportunities, and the opportunity to gain experience with new technologies and management practices.

Currently, farmers have very little control over key issues surrounding their farming enterprises. For example, land tenure and taxation are uncertain, and market information is often ambiguous, untimely and conflicting. The establishment of a more certain operating environment with more equal sharing of control would lead to more trusting relationships between farmers and officials and with other supply chain participants. The more certain environment would create farmer confidence, encourage farmer investment and promote growth throughout the red meat supply chain. The growth would largely be built on the improved quality of the livestock being produced.

Pasture production is low and animal performance is low and inefficient. However, the potential for these farm systems to be improved to yield significantly higher output and income has been demonstrated. The difference in performance is partially due to farmers not possessing the knowledge base and understanding essential to overcoming these production problems. Extensionists and businesses could readily intervene, and extend and facilitate understanding of the underlying principles necessary to improve the performance and sustainability of these farm systems. Such learning will, when combined with greater access to resources and information, act as a catalyst, changing farmer perceptions, allowing farm families to expand their capabilities, improve their livelihoods and increase their contribution to the wider economy.

To enable such access to resources and information and to create greater certainty and security in farmer operating environments, several key changes are necessary:

(i) Longer pastoral leases;

(ii) Fairly enforced tax laws;

(iii) Improved security of livestock and property;

(iv) Relaxation of land use controls;

(v) Relaxation of financial regulations; and

(vi) Improved road and transport networks.

Farmers will only adopt new technologies and practices when they are certain the potential benefits can be realised and will outweigh any costs, and whether the farm family has the desire and capacity to adopt the technology/practice (Section 3.2).

The desire to adopt is related to the farmer's perception of what aspects of the farm production system and business can be managed or controlled. The capacity relates to the farmer's learning and experience, together with the farmer's access to resources and inputs, the certainty of that access and the actual managerial ability of the farmer.

Learning and experience will develop the intuition of farmers, allowing them to deal more effectively with instability and uncertainty (Section 2.3.2). Eventually the knowledge of how to change farm production systems to be both environmentally and financially sustainable, and therefore to be socially sustainable, will be developed. This should offer farm families improved livelihoods. As a family's capabilities expand, their contribution to the wider economy also expands through consumption of goods and services, and participation in off-farm employment, providing long-term benefits to those businesses prepared to help farm families build these capabilities, and to the assisted farm families themselves because their livelihoods are improved. Co-operation between farm families and business would provide benefits to both farm families and businesses alike (Section 5.4.1).

10.3 A new model for sustainable and co-operative development

Co-operation is central to achieving sustainable development. This co-operation needs to encompass the creation of an enabling environment and stronger relationships between participants along the red meat supply chain. Even though farmers at Bei Da Ying expressed reservations about co-operation, because of their past collective farming experiences, it is still concluded that some form of co-operative structure would provide an opportunity for farmers to increase their incomes, become more sustainable and hence improve their livelihood opportunities.

Because of the strongly adversarial and opportunistic relationships that currently exist between farmers, dealers and other supply chain participants, it appears unlikely that these present players could co-operate effectively. Perhaps a third party could facilitate co-operation and manage the relationships, but such facilitation would be time consuming and costly, so would be unlikely to contribute value to the supply chain as a whole. It is also likely that neither farmers or dealers would trust such an organisation or have the inclination to approach one for assistance should they exist. A more feasible alternative is for an integrated agribusiness company to provide all the necessary services and access for individual farmers. This alternative appears more feasible as farmers are more likely to trust an organisation that has given them something first, be that information about markets or technology, fertiliser or a breeding ram. The trust would be greater because opportunism would lie with the farmers, as they would have received the service first. The services the business would need to provide are technical extension, farm inputs and finance. Access to markets and information would also be essential.

A critical number of farmers would need to agree to supply or enter into a partnership with the agribusiness company to justify the investment the company would make, for example, in providing extension services.

Levels of trust could improve and farmers be empowered by the specific investments the company would make at different stages along the supply chain, particularly with respect to extension, and the farmer would have the relationship security of owing the company money if inputs such as fertiliser were also provided (Karen, 1985). Such specific investments would discourage the company from acting opportunely towards supplier farmers. Such a partnership provides farmers who are currently without access to finance, accurate and timely information, technical knowledge and markets, the access to all of these resources, and increased certainty. Similarly, such a partnership offers agribusiness firms the opportunity to gain greater control over a highly variable component of the supply chain: the agribusiness has more direct access to the scarce and strategic pastoral land resource and the people who are prepared to produce red meat from pasture, even though these people are currently producing meat inefficiently and of poor quality (Sections 5.5 and 8.2).

By providing extension services and other resources to the farmers, the company is able to readily access livestock that are produced using company-specified best practices, and are of a higher quality than currently available. The company has more complete supply chain information, because the extension workers are in regular contact with farmers, and are able to feed back farm monitoring information to the company (Section 4.4.2). Thus, the company can manage activities within the supply chain more efficiently. Costs are reduced, certainty is increased and customer requirements are more readily met (Section 4.3.1).

Many development workers may feel that this approach to development benefits the agribusiness company more than the farmers, the targets of development. The feeling may be that farmers are losing their freedom and autonomy, and that the farmers are not being empowered, but rather becoming increasingly controlled. But, how much control do farmers have over their own livelihoods at present? The findings reported in this study suggest the level of control farmers currently are able to exert is very little (Section 8.4 – 8.6).

The development model proposed here may not initially give farmers complete control, or even a high level of control over their livelihoods, but their livelihood capacity would improve, as would the certainty within which they operate. This improved capacity and greater certainty would raise farm family confidence, encourage investment, and offer families the opportunity to build genuinely environmentally, financially and socially sustainable livelihoods.

As the partnership between farmers and the agribusiness company strengthens and evolves, the company is likely to increase its contribution to partnering farm families and the community. As the company expands, the requirement for skilled employees would increase, and farm family children would be well placed to meet this requirement. If the agribusiness company owns or develops its own slaughtering and meat processing facilities, these activities could provide off-farm employment for farm family members. A conceptual model of the farmer-company partnership and supply chain is shown in Figure 10.1.

It is envisaged that any agribusiness company undertaking such a partnership would need to be proven as being, and committed to continuing as, a socially responsible agribusiness company. Such a company also needs to have the human, financial and physical resources to:

(i) Facilitate the establishment of the partnership;

(ii) Manage the information flow along the supply chain; and

(iii) Manage the aspects of the supply chain for which it is responsible.

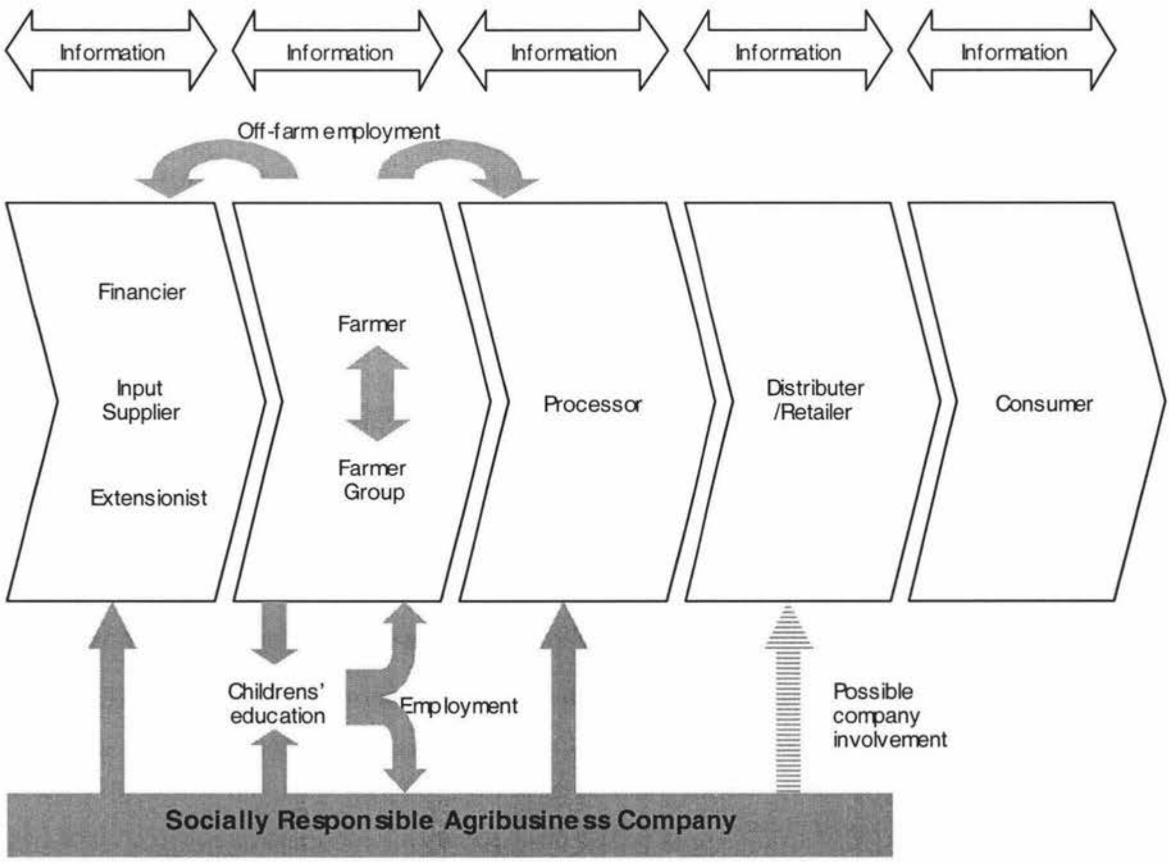

Figure 10.1: Conceptual model of the proposed partnership between a socially responsible agribusiness and farmers, and the resulting value chain. Information exchange occurs freely and is managed by the agribusiness. The agribusiness is involved in the supply chain to the left and the right of the farmers, possibly through to distribution and retailing of the finished products. The socially responsible agribusiness is also central to the provision of employment opportunities for children and farmers seeking off-farm work.

The purpose of such a co-operative relationship between farmers and the agribusiness is two-fold. First, the alliance will improve farm family capabilities, providing them opportunities, and access to information and resources that were previously difficult to obtain. Secondly, the alliance is expected to improve performance of the whole supply chain. The improved performance will arise because of (a) the improved access all supply chain participants have to resources, capabilities and information; (b) the greater certainty in the operating environment; and (c) the better matching of supply chain outputs to customer demands.

The proposed alliance is expected to fulfil these objectives because of the characteristics of the relationship. The partners are interdependent — farmers want access to markets, finance and information, and certainty in this access; and the agribusiness would want greater input into, and control over, how red meat is produced to better meet its market requirements, and access to higher quality livestock. Each of the partners has something of value to offer to the other partner. The partners will establish a trusting relationship — the company extensionist will provide the foundation for this trust, but the extensionist will only be able to develop this trust if supported by the company with stable policies and fulfilled promises. The partners will become committed to each other — the company is largely committed once investment in extension, finance, the supply of inputs, and investment in processing facilities takes place, while farmer commitment will be built upon satisfaction with the relationship. This satisfaction will lead to greater confidence in the other partners and the relationship, which will lead to greater commitment to the relationship. As this commitment to the relationship and each other grows and strengthens, each partner is likely to contribute more to the relationship.

The proposed model offers farm families greater control over their livelihoods, greater certainty within their operating environment, and improved livelihood capabilities. Together, this represents the opportunity for farm families to build genuinely sustainable — environmentally, financially and socially — livelihoods. Further, the red meat supply chain can become a red meat value chain, because information is more readily available, more timely and more accurate, enabling the activities within the supply chain to be better co-ordinated ensuring chain outputs better match customer requirements.

Such a model offers the opportunity to reverse what is currently a vicious cycle of unsustainability and replace it with a self-reinforcing cycle of sustainable development. Although this opportunity exists, several challenges remain before it can be realised. These are the identification of socially responsible and vertically integrated agribusinesses that have the necessary resources and ambition to adopt and implement the model, and to facilitate the creation of an enabling environment in which such partnerships between small-scale farmers and agribusinesses are allowed and are actively encouraged to flourish.

Appendix 1 – Generic goals

Family Goals 家庭目标

F1 To maximize cash income

最大限度的现金收入

F2 To maximize net worth (material item accumulation)

最大限度地提高净产值（资产积累）

F3 To maximize quality of life + leisure

最大限度地提高生活水平

F4 To maximize social status + prestige

最好地树立社会形象和声望

F5 To maximize self-sufficiency

充分提高自我能力

F6 To maximize education of children

尽可能地让孩子得到良好教育

Farm Goals 农场目标

P1 To increase income/profit from farming

增加农场经营的经济效益和收入

P2 Assure stable level of income and output (avoid years of low profit/high losses)

保证稳定的生产和收入水平（避免低收入，高损失年份）

P3 Increase farm resources (number and quality of resources)

增加农场资源（数量和质量）

P4 Reduce labour input

降低劳力投入

P5 Increase net worth derived from farming

增加从农场经营中获得的净产值

P6 Improve quality of life resulting farm involvement in farming

改善农场经营者的生活质量

Appendix 2.1 - Bei Da Ying Traditional Farm Feed Budget

PGR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Native	1	2	2	3	7	15	18	19	12	10	4	2	2905
Improved	2	2	2	5	18	35	42	45	25	17	7	4	6246
Average PGR	1.4	2	2	3.8	11.4	23	27.6	29.4	17.2	12.8	5.2	2.8	4241
MJ ME/kg DM	9	8.5	8.5	9	9.5	10	10.5	10.5	10.5	10.5	9.5	9	
Feed Demand													
Ewes	22	22	22	22	22	22	22	22	22	22	22	22	
ME req't	10.5	8.5	10.5	10.5	10.9	11.3	10.2	18.5	19.5	16.5	14.5	10.5	4628
Total ME	231	187	231	231	239.8	248.6	224.4	407	429	363	319	231	
Hoggets			7	7	7	7	7	7	7	7	7		
ME req't			9	9	10	13	15	16	15	14	14		3514
Total ME	0	0	63	63	70	91	105	112	105	98	98	0	
Lambs	18	18						10	18	18	18	18	
ME req't	9	9							3	5	8	9	1295
Total ME	162	162	0	0	0	0	0	0	54	90	144	162	
Rams	2	2	2	2	2	2	2	2	2	2	2	2	
ME req't	9	9	9	9	11	11	9	9	9	9	9	9	3407
Total ME	18	18	18	18	22	22	18	18	18	18	18	18	
Fattening			11	11	11	11	11	11	11	5			
ME req't			9	9	10	13	15	16	15	15			3125
Total ME	0	0	99	99	110	143	165	176	165	75	0	0	
Cattle	2	2	2	4	4	4	4	4	4	4	4	2	
ME req't	3	3	3	3.5	4	4.5	5	5.5	6	6.5	7	5	
Total ME	6	6	6	14	16	18	20	22	24	26	28	10	
Total ME/ha/day	63.2	56.5	63.2	64.4	69.4	79.2	80.7	111.4	120.5	101.5	92.0	63.8	
Demand DM/ha/da	7.0	6.6	7.4	7.2	7.3	7.9	7.7	10.6	11.5	9.7	9.7	7.1	3034
Supplements fed	3	4	4	5	2								541
Daily Change	-2.6	-0.6	-1.9	1.1	4.6	12.1	14.9	11.8	-4.3	-10.9	-16.5	-9.3	
APC	769	751	691	725	868	1230	1692	2058	1930	1593	1099	811	
Decay	0	0	0.5	0.5	1.5	3	5	7	10	14	12	5	1788
NHP	1.4	2	1.5	3.3	9.9	20	22.6	22.4	7.2	-1.2	-6.8	-2.2	2453
PGR	1.4	2	2	3.8	11.4	23	27.6	29.4	17.2	12.8	5.2	2.8	4158

Average pasture is 40% improved and 60% native

Appendix 2.2 – Bei Da Ying Demonstration Farm Feed Budget

PGR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Native	1	2	2	3	7	15	18	19	12	10	4	2	2905
Improved Low	2	2	2	5	18	35	42	45	25	17	7	4	6246
Improved High	4	5	8	12	32	55	60	63	40	28	12	7	9972
Average PGR	2.3	2.5	3.1	6.1	19.4	36.6	42.8	45.6	26.4	18.3	7.6	4.3	6583
MJ ME/kg DM	9	8.5	8.5	9	9.5	10	10.5	10.5	10.5	10.5	9.5	9	
Feed Demand													
Ewes	100	100	100	100	100	100	100	100	100	100	100	100	
MJ ME req't	10	10	10	12	16	19	17	14	8.5	8.5	9	9	4355
Total ME	1000	1000	1000	1200	1600	1900	1700	1400	850	850	900	900	
Hoggets	25	25	25	25	25	25	25	25	25	25	25	25	
MJ ME req't	8	8	8	8	10	13	15	15	15	15	13	8	4143
Total ME	200	200	200	200	250	325	375	375	375	375	325	200	
Lambs			30	110	110	110	110	110	110	110			
MJ ME req't				1	3	7	11	14	15	16			2054
Total ME	0	0	0	110	330	770	1210	1540	1650	1760	0	0	
Rams	2	2	2	2	2	2	2	2	2	2	2	2	
MJ ME req't	8	8	8	8	8	10	12	12	12	12	12	9	3623
Total ME	16	16	16	16	16	20	24	24	24	24	24	18	
Cattle	8	8	8	8	15	25	25	25	25	25	15	10	
MJ ME req't	4	4	4	4	6	7	8	9	10	10	7	5	
Total ME	32	32	32	32	90	175	200	225	250	250	105	50	
Total ME/ha/day	69.3	69.3	69.3	86.6	127.0	177.2	194.9	198.0	174.9	181.1	75.2	64.9	
Demand DM/ha/day	7.7	8.2	8.2	9.6	13.4	17.7	18.6	18.9	16.7	17.2	7.9	7.2	4610
Supplements	3	4	4	4									449
Daily Change	-4.4	-2.6	-1.6	-0.1	4.6	14.9	18.3	18.8	-2.3	-17.0	-14.3	-10.9	
APC	1062	989	940	938	1079	1526	2092	2675	2607	2081	1651	1314	
Decay	2	1	0.5	0.5	1.5	4	6	8	12	18	14	8	2307
NHP	0.26	1.54	2.58	5.56	17.92	32.6	36.84	37.64	14.4	0.28	-6.4	-3.66	4276
PGR	2.26	2.54	3.08	6.06	19.42	36.6	42.84	45.64	26.4	18.28	7.6	4.34	

Average pasture is 20% improved high and 80% improved low.

Appendix 3.1 – Farmer locus of control survey questions

Question 1

- *Despite a farm's location, climate and markets, I believe there are always opportunities to alter and adapt the combination of enterprises on that farm*
- On my farm the combination of location, climate and markets just about restricts me to the one combination of enterprises

Question 2

- *For most new ideas, I generally find that with time and effort I can get them to work on my farm*
- I generally find that most new ideas that come out do not really apply to my farm

Question 3

- *Even in today's economic conditions there are frequent opportunities to expand, develop and intensify my farm*
- The current economic conditions make it very difficult to further develop my farm

Question 4

- *Because each year is different from the last, I prefer to set up a new plan each year*
- Because farming is such an uncertain business, I find it is best to follow fairly closely the plan I have used in recent years

Question 5

- For a farm like mine, working out its strengths in great detail wouldn't really help me much because so much of what happens outside the farm gate is out of my hands anyway
- *In my experience, working out the strengths of my farm in some detail often gives me useful leads for the future*

Question 6

- *In my experience, identifying the threats and opportunities facing my farm can often give me a good idea of the direction that I should be going*
- For a farm like mine, working out the threats and opportunities wouldn't help me much because you cannot do much about what happens outside the farm gate anyway

Question 7

- In my situation, it is difficult to plan activities in advance because most of the factors that influence timing of events are out of my control
- *It is generally possible to plan activities ahead of time and fine-tune exact timing based upon climatic conditions at the time*

Question 8

- For farmers like me it is easier to buy things when I have money and sell things when I don't – financial planning is of little value because prices are so volatile
- *I try to plan ahead the times when I will sell and buy animals and necessary items so that I always have some spare money to pay for unforeseen costs*

Question 9

- *I generally find that even though climatic conditions change from year to year, I can still make improvements to both my cropping and pastoral systems' performance*

- For a farm like mine, it is very difficult to make improvements because the seasonal conditions vary so much between years

Question 10

- *I have found that I can minimise the effect of plant pests and diseases on crop yield by using crop rotations*
- I have found that the incidence of plant pests and diseases depends more upon the season rather than my management practices

Question 11

- *In my situation it is generally well worth putting a lot of effort into getting the crops in the ground as near as possible to the ideal sowing date*
- For a farm like mine, it is not worth the effort to sow crops at the ideal sowing date because the weather is out of my control

Question 12

- *From my experience, I can maintain improved pasture species and a good level of pasture production by applying fertiliser to the pasture*
- For a farm like mine, fertiliser does not help maintain improved pastures in the highly productive state

Question 13

- *From my experience, I have found that I can usually prevent most animal health problems before they occur and that there is value in such prevention*
- From my experience, I have found that there is little value from trying to prevent animal health problems because the problems that occur depend upon the seasonal conditions at the time

Question 14

- *In my experience, I have found that I can turn pasture surpluses into feed reserves even though the largest surplus occurs in the summer rainy season*
- For a farm like mine it is usually very difficult to conserve pasture for future use because of unsuitable weather conditions

Question 15

- For a farm like mine, it is very difficult to control the timing of lambing
- *On my farm, I can readily make adjustments to the timing of lambing to improve sheep performance*

Question 16

- *I know the type of animals the market requires and usually receive some reward for providing those animals at a time when demand is high*
- In my situation, there is no advantage in trying to guess the type of animals with the highest value as it is very difficult to know what sort of animals the market requires and when they are wanted

Question 17

- *In my experience, I have found that pasture quality and animal performance can be improved by changing the mix of livestock grazed*
- On a farm like mine, seasonal conditions do not allow pasture quality to be managed

Question 18

- In my situation, there is no advantage in timing events such as lambing and buying and selling animals to better match pasture supply and feed demand because markets are out of my control
- *In my experience, changing animal feed demand to match supply usually provides significant financial advantages*

Question 19

- *In my experience, I can always ensure sufficient feed on hand to fully feed my livestock*
- For a farm like mine, it is very difficult to ensure an adequate feed supply over the whole year because the pasture growth is so seasonal

Question 20

- For a farm like mine, making improvements to the pasture areas is not worthwhile because so much of what happens is outside the farm gate
- *In my experience, investing in farm developments usually enhances farm profitability in the current year and for the future*

Question 21

- *In my situation it is possible to achieve high animal performance targets when I want by managing my feed supply*
- For a farm like mine, it is not worthwhile to set animal performance targets because liveweight gains and feed supply are out of my hands

Question 22

- *I have found that by protecting my pastures from over-grazing and applying fertiliser I can be assured of having good pasture production in the following year*
- For a farm like mine it is very difficult to ensure my future pasture production because it is so dependant upon the weather

Question 23

- *Future crop yields can generally be assured provided adequate fertiliser or manure is applied*
- Crop yield cannot be assured by fertiliser or manure application – it is far more reliant upon factors out of my hands

Question 24

- *I can readily obtain market information for my region*
- For my region, market information is very difficult to obtain

Question 25

- *I frequently use market information to adjust my farm plan*
- I do not use market information in making decisions because the information is often out of date or inaccurate

Appendix 3.2 – Farmer locus of control survey questionnaire

农场调查问卷

请回答所有问题。从（a）和（b）中选出你最赞成的成述。在选中的成述旁的方框内打☑.

问卷一

(a) 除农场的位置、气候和市场外，我相信总有机会来对农场产业的组合进行改变或适应性改编。 ☐

(b) 在我的农场中，位置、气候和市场的组合恰好是限制我的一个产业组合。 ☐

问卷二

(a) 对大多数新技术和新主张，一般来说我有时间并能努力尝试，使它们在我的农场产生作用。 ☐

(b) 一般来说，我感觉到新技术和新主张不适用于我的农场。 ☐

问卷三

(a) 即使在目前的经济状况和条件下，仍有不少的机会来扩大、发展和强化我的农场。 ☐

(b) 在目前的经济状况和条件下，要让我的农场进一步发展非常困难。 ☐

问卷四

(a) 因为每一年都与往年不同，所以我每年都制定新的计划。 □

(b) 由于农场经营是多变的经营，我感觉到最好还是相当接近地按照近几年我使用的计划实施。 □

问卷五

(a) 对于一个农场来说，制定出过于详尽的计划，并不能产生多大的用处，因为农场以外所发生的一切是我力所不及的。 □

(b) 根据我的经验，根据农场上限制定较为详尽的计划能为农场的今后发展产生指导作用。 □

问卷六

(a) 根据我的经验，确定我的农场所面临的限制因素和发展机会对指导今后的发展方向很有帮助。 □

(b) 对于一个农场，列出限制因素和发展机会用处不大，因为农场以外发生的一切我无能为力。 □

问卷七

(a) 就我的情形而言，制定今后的生产活动计划很困难，因为影响事情时机的大部分因素不是我能控制的。 □

(b) 一般地，可以提前制定计划并根据气候状况精确地调整确切的时机。 □

问卷八

(a) 对于农户来说（比如我），当我有钱的时候易于购进东西而当我没有的时候又可以出售东西——财经计划具有较小价值，因为价格经常变化。 □

(b) 当我要出售和购进家畜和其他必需品时，我尽量提前作出安排，这样我总是有一些资金支付不可预见的成本。 □

问卷九

(a) 一般来说，尽管气候条件的变化一年与一年不相同，但我仍能够提高我的农作物和草地系统的运作。 □

(b) 对于一个农场来说，要提高其运作非常困难，因为年与年的季节气候变化很大。 □

问卷十

(a) 我发现通过作物轮作，我能将植物病虫害的危害减少到最低程度。 □

(b) 我发现植物病虫害的发生率和程度取决于季节而非管理操作。 □

问卷十一

(a) 就我的情形而言，通常值得采取措施尽可能在最佳播种期播种。 □

(b) 对于一个农场来说，尽力在最佳的播种期播种并不值得，因为我们控制不了气候。 □

问卷十二

(a) 就我的经验而言，我能通过草地施肥来维持改良草地中的优良牧草品种和草地生产水平。 ☐

(b) 对于一个农场来说，肥料并不能维持改良草地的高生产力水平。 ☐

问卷十三

(a) 就我的经验而言，我能够通过预防措施防止大多数家畜疾病的发生，因此家畜预防很有价值。 ☐

(b) 就我的经验而言，家畜疾病的预防没有价值，因为疾病的发生取决于当时的季节条件。 ☐

问卷十四

(a) 就我来说，我能将草地剩余牧草甚至夏季雨季期出现的大量剩余牧草储备起来，（以作为缺草期的家畜饲草）。 ☐

(b) 对一个农场来说，储备牧草作为缺草期饲料非常困难，因为气候条件不允许。 ☐

问卷十五

(a) 对一个农场来说，要控制产羔期非常困难。 ☐

(b) 在我的农场，我能容易地调整产羔期以提高绵羊的生产性能 ☐

问卷十六

(a) 我了解市场需求的家畜类型，并在市场需求最大时及时提供这些家畜以便得到较好的效益回报。 ☐

(b) 就我而言，尝试猜测市场价值最高的家畜类型没有什么可能，因为要了解市场所需的家畜种类和时机非常困难。 ☐

问卷十七

(a) 根据我的经验，我发现通过改变放牧家畜的组合能改善草地质量和家畜生产性能。 ☐

(b) 对一个农场来说，季节状况不允许对草地质量进行管理。 ☐

问卷十八

(a) 就我的情形而言，我不能适时安排生产活动，如产羔期、买卖家畜时间等来平衡草地供给和饲料需求，因为市场在我的控制之外。 ☐

(b) 就我的经验，改变家畜的饲料需求使之与饲料供给相吻合，一般都能得到更好的经济效益。 ☐

问卷十九

(a) 就我的经验，我总能够拥有足够的饲料来充分饲养我的家畜。 ☐

(b) 对于一个农场，要保证全年的充足的饲料供给非常困难，因为草地生长的季节性很强。 ☐

问卷二十

(a) 对于一个农场的草地面积进行改良并不值得，因为农场以外发生的事情很多。 ☐

(b) 就我的经验而言，对农场发展的投资在目前和今后都会提高农场效益。 ☐

问卷二十一

(a) 就我的情形而言，在需要的时候，通过对饲料供给进行管理就可能达到高的家畜生产指标。 ☐

(b) 对于一个农场，不值得制定家畜的生产表现指标，因为对于家畜日增重和饲料供给等我无能为力。 ☐

问卷二十二

(a) 我发现通过保护草地使之免于过牧并施肥，我能在来年得到很好的草地产量。 ☐

(b) 对于一个农场要保证今后的草地产量非常困难，因为草地产量取决于气候。 ☐

问卷二十三

(a) 一般地，通过保证施用足够的肥料或农家肥就可进一步提高作物产量。 ☐

(b) 保证肥料或农家肥的施用并不能提高作物产量，因其更多地依赖于我不能控制的其他因素。 ☐

问卷二十四

(a) 我能够获得本地的市场信息。 ☐

(b) 在我的地方，要获得市场信息非常困难。 ☐

问卷二十五

(a) 我经常依据市场信息来调整农场计划。 ☐

(b) 我没有依据市场信息来制定农场的生产决策，因为这些信息是过时的和不准确的。 ☐

谢谢您!

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