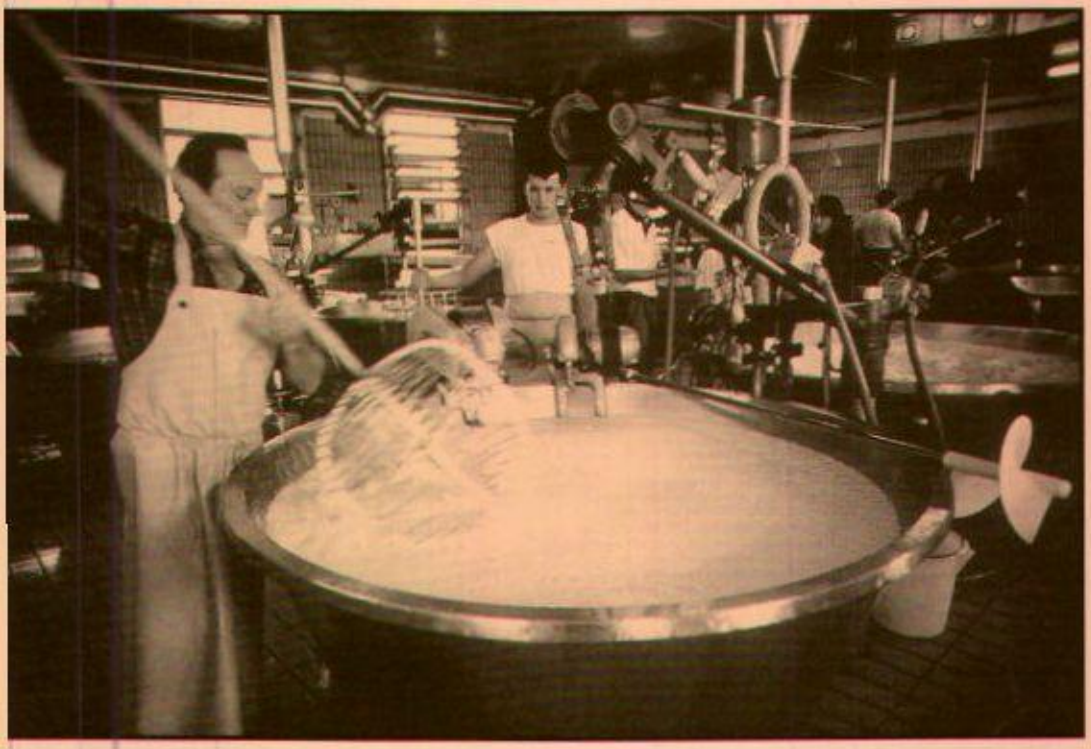
Kees de Roest



THE PRODUCTION OF PARMIGIANO-REGGIANO CHEESE

The force of an artisanal system in an industrialised world

Stellingen

1. Strong culinary traditions and deeply rooted town-countryside relations result in the willingness of Italian consumers to pay more for regional specific products and services. This willingness is particularly favourable to local and regional rural development.
2. Artisanal production techniques are essential to the maintenance of mutual and manifold links between product quality and local ecology (see Chapter 4).
3. Preserving the high quality of Parmesan cheese implies a specific multifactor and multilevel technology trajectory that contrasts sharply with the trajectory that dominates in industrialised dairy systems (see Chapter 8).
4. In contrast to other dairy farms, the regime followed on Parmigiano-Reggiano dairy farms can only be assessed if an eight-year average is taken into account (see Chapter 10).
5. The concept of social quality is essential to an explanation of regional specific food products (Casabianca & Valceschini 1996).
6. The application of district theory in agriculture is essential if the dynamics of rural development are to be fully understood (Iacoponi 1990).
7. The maintenance of the milk quota regime favours employment on Italian dairy farms. If this regime were to be abolished, it would be extremely positive for the profitability of large-scale dairy processing.
8. A thorough understanding of the mechanisms ruling the dynamics of regional specific products in Southern Europe might be helpful in strengthening employment levels in Dutch agriculture.

Stellingen behorende bij het proefschrift van K. de Roest

The Production of Parmigiano-Reggiano Cheese

The Force of an Artisanal System in an Industrialised World

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The Force of an Artisanal System in an Industrialised World

Kees de Roest

Proefschrift
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Kees de Roest
Reggio Emilia 18 September 2000

1 Introduction

The dynamics of endogenous development in local agricultural systems has been the subject of a series of recent European studies. Interest in the socio-economic benefits of producing foods that derive their quality from locally defined and regionally specific factors is growing. These can be readily distinguished from industrially produced foods and are usually made using artisan techniques. Local natural and physical factors are very important in their manufacture. Two questions arise from the growing significance of this type of product. First, to what extent can it contribute to rural development and what conditions must be present to determine success.

This study focuses on the significant example of Parmigiano-Reggiano cheese[1], a product of Northern Italy providing an excellent example of a local agricultural production system in which the elements of endogenous development predominate. A chain of vertically-related economic actors are linked together and derive the major part of their revenue from producing the cheese. In many ways the system can be defined as emblematic and unique. Most of the milk is produced on small- or medium-sized dairy farms. It is then processed into Parmigiano-Reggiano cheese in hundreds of small-scale dairies that receive milk daily from some twenty farmers.

Within Europe there are many types of dairy farms. Their structure depends on what is being produced, the technology applied, and the climatic and physical geography of the area. Large- to medium-sized dairy farms, for example, characterise countries in the northern parts of the European Union such as the United Kingdom, the Netherlands, Schleswig Holstein and Denmark. These service a dairy industry that produces mass quantities of liquid milk, cheese, milk powder, butter and yoghurt. Such highly specialised dairy farms achieve their high incomes by exploiting the economies of scale possible on large farms and by taking full advantage of favourable, often humid climatic conditions, that make

possible good yields of high-energy roughage (Butault *et al.* 1992; Isermeyer 1988; Zeddies 1989).

Highly differentiated dairy sectors are found in France and Italy. On the one hand there are the industrial systems of Brittany, Lorraine and Lombardy, for example, which are very similar to the dairy systems of northern Europe. On the other, there are systems that are heavily dependent on the local ecology and climate and, in general, make intensive use of artisan labour to produce one final product (Ricard 1994). Parmigiano-Reggiano cheese is a good example of this type of production system: its production is specific, localised and heavily determined by the physical and socio-economic character of the area. Parmigiano-Reggiano cheese manufacture has a long history and variations in quality and production processes can be largely explained by local socio-economic conditions. Over the years the organisation of production has been modified, but most of its distinctive features remain intact. These serve to differentiate the Parmigiano-Reggiano system from dairy systems that are more heavily dependent on exogenous development factors. Although conflicts may arise between different sub-areas within the system, strong cohesive interests are able to maintain its integrity. Technologies used on the farm and in the milk processing plants may differ significantly, but common, locally-based technological features distinguish the system from those dairy systems that are more open to universally applied technologies.

The most significant difference between an industrial and artisan system is the difference in the ratio of capital to labour. Global industrial systems are distinguished by large-scale processing units supported by a universal technology and heavy inputs of capital. The local artisan system is usually characterised by a low capital to labour ratio and specific technology (Braverman 1974). Although in both systems the final valorisation at the consumer stage of the milk marketing chain may be the same, an industrial system will remunerate primarily invested capital and an artisan system will remunerate high labour input in particular.

Throughout Europe, large-scale dairying ensures that the milk delivered by hundreds of thousands of dairy farmers is transformed into a growing number of dairy products all of which contribute to a steady growth in added value (Rama and Pieri 1995). Labour saving technologies are constantly being introduced and the final quality of the end product has to conform to specific hygiene and public health standards.

As an artisan system, Parmigiano-Reggiano cheese production is guided by a wider concept of quality. Hygiene and public health criteria are taken for granted and the definition of quality involves other types of attribute such as genuineness (manual and artisan milk processing) and the specific features of the region where the cheese is made. In a local artisan system new technology is either the product of controlled and filtered innovations generated outside the system or is endogenous in origin.

The development path followed by global, industrial dairy systems involves the adoption of universally applicable innovations generated by research centres located in different parts of the world. The local, artisan Parmigiano-Reggiano system is characterised by a low capital to labour ratio and by production techniques that cannot easily be reproduced. The artisan nature of the production techniques involved in making Parmigiano-Reggiano cheese is one of the main reasons why it provides an interesting case study of a very specific economic system.

Another reason why Parmigiano-Reggiano cheese makes an interesting case study is that, unlike many other regionally specific products, it does not occupy a niche market. Almost 15 percent of Italian milk is processed into Parmigiano-Reggiano cheese. Emilia-Romagna, where Parmigiano-Reggiano is produced, is the second most important milk producing region in Italy. In production terms Parmigiano-Reggiano is the most valuable cheese in the country. It is sold all over Italy and five percent of total production is exported.

Artisan cheese production systems are found throughout Europe and there are many in the Mediterranean region. However, usually these systems have a very local market and limited production (INSOR 1991). Technically, their development often follows a specific and local trajectory and they are less subject to external pressure from the agricultural machine industry to adopt mechanical innovations. However, the fact that Parmigiano-Reggiano cheese has such a large share of the market may makes it vulnerable to exogenous forces wishing to alter and standardise the product in order to capture part of its high added value.

A third reason why Parmigiano-Reggiano cheese makes an interesting case study is that it retails at a high price and this contributes to the added value of the product. Consumers are very willing to pay for this quality cheese and it is an important ingredient in many Italian dishes. Parmigiano-Reggiano is regarded as having the best qualities among the hard, ripened cheeses that are grated before use, and this fact is reflected in its retail price. Consumption of Parmigiano-Reggiano is not only high

within the production area itself, but it has a large share of the market throughout Italy.

Fourthly, because artisan techniques feature prominently in production, the high added value of the product favours the employment of labour in the system. Many other dairy products may have a high added value, but the Parmigiano-Reggiano system remunerates labour rather than capital resources, as the labour to capital ratio is higher than in other dairy systems. The heavily co-operative structure of the cheese dairies also contributes significantly to maintaining employment and to a more equal distribution of added value among the actors in the system.

Finally, the physical conditions under which Parmigiano-Reggiano is produced are quite special. More than 70 percent of Parmigiano-Reggiano production takes place on the fertile, highly productive plains. The remaining part is produced in the hills and mountain areas which are characterised by less favourable conditions. The associated variation in the potential of physical production has created different economic growth patterns more or less open to technological innovations generated outside the system. The production techniques of the hill and mountain dairy farms are much more closely related to their specific local traditions. In these regions, there are physical and natural features that impede the introduction of technologies that could be easily adopted on the plains. The extra added value and the high demand for labour generated by the system favours the development of these less favoured areas of Parmigiano-Reggiano production and supports a high level of employment. This is in contrast to neighbouring areas with similar physical and natural conditions. In this way the Parmigiano-Reggiano system acts as a barrier to the marginalisation of agriculture, a process that has caused serious depopulation in other parts of the Italian Appennines.

The Parmigiano-Reggiano cheese production system provides an ideal laboratory for carrying out a socio-economic study into the dynamics of endogenous development under pressure from exogenous forces. The features of the Parmigiano-Reggiano system mentioned above can, of course, be found elsewhere in Europe. Small dairy farms with discrete income levels are common in northern Spain and central France and artisan conversion of milk into local cheese is a feature of some parts of Great Britain and the Netherlands (Wilson 1997; Van Ittersum 1997). The uniqueness of the Parmigiano-Reggiano system, however, is that all the characteristics mentioned above occur simultaneously in one area. Small dairies, using artisan techniques and guided by a quality concept that is

linked to the cultural patrimony of the local production area,[2] are able to maintain a huge cheese output. At the same time, the system is capable of sustaining high employment levels. It is questionable whether the Parmigiano-Reggiano system will continue to maintain its distinctive characteristics. Will the system resist external pressure to adopt technologies that may interrupt its links with local human and natural resources or might the actors themselves decide to abandon current production techniques and turn towards a greater degree of standardisation?

It should be stressed that the system has not always been embedded in the same archaic and traditional methods of production. Significant changes have taken place in the breed of cow, feed and fodder composition, and the technologies used in milk processing. Not only have the technologies changed on the farms and in the processing plants, but a substantial change has also occurred in the social organisation of production. Nine hundred years ago the milk was processed by Benedictine monks; today co-operatives predominate. There is considerable variation in the economic size of the plants. It is rather difficult to identify a representative Parmigiano-Reggiano processing plant and production styles vary throughout the Parmigiano-Reggiano region.

Despite these differences and variations in styles of production, technological innovation has not altered the original basis and uniqueness of the product. The introduction of exogenous elements has been subordinated to the necessity of maintaining the originality of the product. An absolutely endogenous, original product has, in this way, be able to maintain its sovereignty over external elements. There is a common code of behaviour that is accepted by all actors in the system. Everyone understands the technical and economic implications of the production process behind the success of Parmigiano-Reggiano cheese. At the same time everyone is aware of the conditions necessary for producing industrial milk. These are considered to be two separate cultures, because they are based on completely different production techniques. Once a farmer has chosen to produce milk for Parmigiano-Reggiano cheese, he or she will find it very difficult to step into another market.

This leads to the question of how the Parmigiano-Reggiano cheese system has be able to successfully maintain its authenticity and originality. To what extent has the endogenous nature of the Parmigiano-Reggiano system been responsible for maintaining the system as a whole and for

ensuring its originality? There is no single element or cluster of elements that can be identified as having been responsible for preserving originality and the integrity of the system. Any analysis has to go further and penetrate the complex interactions and interrelations between actors within and outside the system. None of these single interrelations are fully able to explain this particular type of endogenous development. Methodologies based on standard economic theory do not provide an adequate interpretation of the system. A holistic or global 'quid' that encapsulates the whole sequence of atomistic relationships that make up the elements of the system is needed. Although it is important to analyse cost and price to quantify the employment effects in the upstream and downstream economies and to demonstrate different levels of income distribution within the system, the explanations generated will not provide a full answer to the questions raised earlier. The persistence in time and space has to be linked to a 'system factor', that cannot be considered to be a simple combination of all favourable, interrelated elements. If this were the case, the many transformations that have occurred in the past would have introduced significant changes and alter it in such a way that it might have lost its original characteristics and be dragged into the unlimited, anonymous market.

It might be said that there is a 'common interest' in maintaining and developing the link between product and production area. This common interest is not limited to the actors in the production process, but can extend to all actors including those involved in the supply industry and in the commercialisation of the product. A kind of culture has arisen around Parmesan cheese and it is one that extends beyond the actors directly involved in its production.

Becattini (1987a) raises the question of how to classify the economy in single industries. The fundamental question here is how to define a stable aggregate of firms capable of giving a rational and uniform base to behaviour? One of the problems of trying to define an industry is isolating a part of the industrial system in order to study it. After discussing classical economic categories in industries based on similar goods and technologies, Becattini identifies a third possible way of developing a classification: 'the sense of belonging, whose characterising element is the consciousness of the actors that they belong to a certain industry' (Becattini 1987a).

For many years, local endogenous developments have attracted an increasing degree of scientific interest. The main characteristic of endogenous development is its capacity to retain the benefits of economic

development within the *locale* (Slee 1992). Generally this type of development is based on small- to medium-sized farms with highly intensive inputs of labour. The economist is interested in the persistence of small farm enterprises within local systems because standard economic theory has been unable to capture the phenomenon adequately. A gap has arisen between the methodological instruments of neo-classic economic theory and the way empirical reality has evolved. The demise of the small farm has often been predicted but the empirical facts have not confirmed this prognosis.

The internationalisation of markets and enterprises pose a potential threat to the Parmigiano-Reggiano system. It is argued that this process might provoke a divergence in the way different agricultural regions within Europe develop and result in the creaming-off of benefits created within local systems. A further internationalisation of enterprises is favoured at the political level. Here there is an uncritical acceptance of the neo-liberal concepts of standard economic theory. Although there are many nuances within this theory, Pareto's concept of welfare states that a general economic equilibrium can be reached when no economic subject is able to increase his or her proper welfare without reducing the welfare of another neighbouring subject. To reach this optimum level all barriers to free trade have to be eliminated. Only complete free trade can get rid of the inefficient, small enterprise. According to this view, local artisan production systems, within which small-scale enterprises operate, are destined to disappear as the global market grows. The best they can hope to attain within this vision is the exploitation of some niche markets that the global market cannot reach.

In this study an attempt will be made to investigate the mechanisms and factors which explain the continuity and the survival of the Parmigiano-Reggiano system. It must be stressed that there is no single economic theory that can explain the development of local territorial systems (Romano 1995). Of necessity, this study will rely upon a set of theories that seem to offer the most incisive approach to the reality being discussed.

Standard economic theory is inadequate to explain the empirical reality of Parmigiano-Reggiano's success. It is therefore necessary to go beyond the marginalist theory of economic behaviour that fails to take into account the geographical and historical contexts that determine the actions of economic agents. Standard economic theory does not adequately consider the way local factors influence economic behaviour. It postulates that the firm is indifferent to the source of its raw material and the origin of semi-

manufactured goods and labour. It also has little interest in the ultimate destination of end-goods and services. Distance, the spatial element, is defined simply in terms of transport costs (Becattini 1989). This is the first weakness in the explanation offered by standard economics for the geographical localisation of economic activities. In recent years transport costs have declined rapidly and are now a very limited cost item in the economic sector. From a more general perspective, however, economic theory can only explain some elements of social behaviour and therefore it is unable to provide a comprehensive view of the development of social systems. A principal defect of standard economic theory is its rigidity in treating social, cultural and historical variables as exogenous and as constraints to economic behaviour. There cannot be any economic theory when important causes of change in the economic system (technology, tastes, demographic conditions) remain outside the analysis (Quadrio Curzio and Scazzieri 1990; 15). As has been stated in a study on the differences in dairy systems in Europe, to understand the rationale behind these differences it is necessary to take account of the social consensus on the role and logic of the way the dairy farm functions (Ruffio 1990).

Although standard economic theory is inadequate, some of the economists who have made a contribution to its construction can provide useful insights into the process that has allowed small enterprises to survive despite a continuing increase in the scale of the economy. Here I would refer to the theory of industrial districts introduced by Marshall and rediscovered in the 1980s when the economic analyses of Italian industry became interested in the development of local production systems which consisted mainly of small- and medium-sized enterprises (Becattini 1987; Garofoli 1989). Their main concern was how small firms in restricted areas achieve high economic performances without being able to exploit the economies of scale offered by new labour saving technologies.

Until the 1980s, the economic theory of development was based on the superiority of the large enterprise that was able to successfully compete on the market because it could exploit economies of scale. Census data demonstrated increasing employment in small- and medium-sized enterprises in north-eastern and central Italy[3] and a decline in employment opportunities in the large enterprises of the industrial triangle (Milan, Turin, Genova). These trends formed the basis of a debate that centred on an analysis of the reasons for the persistence and survival of the small firm (Bagnasco 1977). At the time, however, the majority of economists saw economic development in terms of the development of the large firm which, because of the division of labour within it, was able

to exploit internal economies of scale. Only a very few economists had come to question this approach to development. One of the few significant exceptions is the theory of flexible specialisation stressing the ability of the small firm to innovate more rapidly than the large Fordist enterprises because it is able to make better use of individual human capacities (see Piore and Sabel 1984).

Census data collected from the industrial sector in 1981 brought further evidence of the capacity of small firms to create employment. Over the years it has been statistical evidence that has undermined the dominant theory and its inherent policy on economic development (Becattini and Bianchi 1987). In the 1980s the concept of the Marshallian Industrial District was developed further and started to go beyond the 'Third Italy' as a indistinct geographical area. A detailed analysis was made of hundreds of different industrial districts each of which specialised in the manufacture of one main product[4] (Sforzi 1987). In these districts small, extremely flexible and dynamic firms often produce high quality products for both domestic and export markets. The application of the industrial district concept to the agri-food sector has been proposed by Iacoponi (1994) and is recently adopted as a tool of agricultural policy in Italy.

A fundamental theoretical explanation for the economic efficiency of the small firms lies in the presence of economies external to the firm that are generated within the district. These become internalised in the firm's balance and alleviate its overall production costs. Some externalities that come to mind are the economies of agglomeration, technical progress and innovation. An industrial district is characterised by a network of relationships between economic actors. The close mutual proximity of actors and the interchange of specific knowledge inhibit efforts to fully exploit internal economies of scale within the enterprises. If internal economies of scale contribute to increased efficiency within the large firm, the mere geographical concentration of numerous small, specialised and strongly interconnected firms creates these economies of scale and each individual firm is able to exploit these to its own advantage. Of particular relevance to the origin of a district is the condition that the production process can easily be decomposed, is flexible and has limited economies of scale (Saccomandi 1994; p.22).

These are precisely the arguments used by Marshall in the second half of the nineteenth century in an attempt to explain the presence of small textile firms concentrated in Yorkshire and Leeds, in the British Midlands, that were able to compete on the market. Marshall's ideas are a product of a period when classical economic theory was dominant and when it was

believed that economies of scale could be achieved within a large enterprise where division of labour was possible. Marshall introduced the concept of external economies that were equivalent to internal economies. These could be exploited by small firms when they were sufficiently close to each other and when the production process could be easily decomposed into single phases that could be performed efficiently by small firms (see Tani 1987).

Two aspects of the Marshallian industrial district need to be stressed. First, despite the concept's limitations and peculiarities, it offers a possible point of departure for a general reflection on socio-territorial systems that challenge the dominance of standard economic theory. Second, its advantage lies in making possible an analysis of social phenomena that includes the historical and geographical context of economic actors (Becattini 1987a). It is important to stress, however, that the mere geographical concentration of firms is, in itself, insufficient to sustain the economic efficiency of firms in an area. The nature of economic relationships between the firms is decisive for the solidity and competitiveness of the district. Here the concept of the costs of using the market or transaction costs introduced by Coase (1937) and further elaborated by Williamson (1975) is critical. To know whether a district will continue to exist, one has to investigate why the costs of using the market are lower in one district than they are in another. When transaction costs within a concentration area of specialised firms are high one is dealing with a specialised production area and not a Marshallian industrial district. Within such areas it is more difficult for small firms to survive because external economies, although present, are only translated into the firm's balance to a limited extent. The advantages of geographical concentration in this case are less decisive for the economic efficiency of the firms.

These considerations suggest that the economic relationships between firms have to be subject to research before the dynamics and competitiveness of industrial districts on the global market can be fully understood. In recent decades, the attention of many economists and researchers has shifted from an analysis of the firm to an analysis of market relations between firms. Whereas in neo-classical analysis – under the hypothesis of perfect competition – the market is treated as an exogenous and given factor, in the neo-institutional approach it is stressed that the costs of using the market are not zero (Williamson 1985). Each transaction generates costs because of opportunism, uncertainty and ambiguity in the relationship between economic agents (Dei Ottati 1987).

Instead of studying the firm as an entity, Williamson considers the transaction as the basic unit of analysis.
The concept of transaction costs has attacked the basic axioms of the marginalist theory that assumes that economic actors have a perfect knowledge of prices and that there is no uncertainty in market relations. When transaction costs are taken into account, the boundary of the firm becomes more fluid and consequently the issue of optimal economic size, although still relevant, looses importance. To evaluate the economic viability of the firm, not only must internal production costs be investigated, but also the costs of the transactions involved in securing the delivery of raw materials and services and in selling the final goods must be examined.

At this point in the analysis economic theory is no longer sufficient because the relations between firms are strongly influenced by the social context and culture of the economic actors. Without a complete understanding of the social behaviour of the economic actors, no progress can be made in the analysis of the nature of their mutual relationships. The competence of the economist has to be enlarged to facilitate the study of how and why local systems rise and decline (Becattini 1989; p.16). 'Important too is the continuous interaction between economic activities and the 'social culture' (systems of values), the whole set of economic, social and cultural variables which condition the nature of the social and productive structure, the relationships between and behaviour of actors' (Garofoli 1989; p. 76). The external economies will only be internalised when the relationships between firms are based on reciprocal co-operation (Dei Ottati 1987). It are precisely these economies that enable different technologies and production techniques to be adopted and the establishment of different, related firm strategies between different areas producing the same product. These phenomena cannot simply be explained by relative factor prices (Garofoli 1989).

The existence of regional-specific development paths in agriculture that are primarily based on sources of endogenous development has been stressed by Van der Ploeg in many publications (Van der Ploeg 1990; 1994). An important analogy can be drawn with Garofoli's remark concerning the possibility of divergent firm strategies partially independent of relative input-output and factor prices. Different styles of farming are distinguished in agriculture within a homogeneous economic environment. An important distinction between farming and industry is that farming needs the resource 'nature' which is even more region-specific. It is precisely the diversity in the relations between farmers and input markets that gives rise to different farming styles: at one extreme a

relatively autonomous style of farming based on endogenous factors, at the other a more market-dependent style based on more exogenous sources of development. Farmers relate their farm enterprises in many different ways to markets, and although markets might represent one and the same set of external parameters for farming, the way in which farming is linked to this set of parameters is highly variable (Van der Ploeg 1994). Markets and technology do not determine how farming will be conducted: they provide the context in which different positions are possible. Hence markets and technology constitute room for manoeuvre (Long 1984). Empirical evidence of the existence of different styles of farming is abundant in the literature (De Bruin and Van der Ploeg 1991; Van Broekhuizen and Renting 1994; Antuma *et al.* 1993). The essential point is that different styles of farming can be discovered and understood only when the behaviour of actors is extended beyond the economic to include the social and historical context in which they operate. When this is done it becomes possible to understand why some farmers are more market dependent than others and why dairy farmers may follow quite different strategies of development.

The persistence of industrial districts in time depends, according to Garofoli, on continuity in technological innovation, the efficient circulation of information, a capacity to control the market and the strong integration of local institutions into the local economy (Garofoli 1989). All these factors can be controlled from inside the district. From the neo-institutional point of view the persistence of local production systems with significant elements of endogenous development proceeds from the high transaction costs (new commercial relationships have to stipulated) and transformation costs (new technical knowledge have to be acquired) that occur if actors decide to quit the system. In other words, there are considerable benefits (i.e low transaction and transformation costs) related to the decision to stay inside the district. If the benefit/cost balance in the neo-classical firm-centred view may in certain periods demonstrate the economic convenience to the firm of quitting the system, the high transaction and transformation costs introduced by the neo-institutional theory will continue to link the firm to the system.

As has been stated above, the boundary of the firm becomes less defined. In neo-institutional theory the firm as an entity for research is, in fact, abandoned. The economic world is composed of organisations and markets. How to produce is an important question in this respect: in one single, vertically-integrated organisation or in a series of vertically co-ordinated organisations. In the first type of organisation internal co-ordination generates bureaucratic costs. In vertically co-ordinated

organisations, co-ordination is performed by markets that generate transaction costs. In other words, the interactions of individuals within an organisation are co-ordinated by rules complemented by prices, whilst the interaction on markets between actors are co-ordinated principally by prices and complemented by rules (Favereau 1995).

In this respect Porter's arguments are eloquent. In his theory of the value chain, Porter (1985) distinguishes ten principal cost determinants. These are economies of scale and the way production capacity is utilised; the learning process; vertical relationships with delivering firms; relationships with firms at the same stage in the value chain; the time factor; firm strategy; the geographical location of the firm and institutional factors. Economies of scale and the utilisation of production capacity represent nothing new as far as neo-classical economic theory is concerned, but the other cost determinants listed belong to the institutional approach of economic theory. Porter particularly stresses the importance of the way each firm relates its own value chain to the value chain of up- and down-stream firms in the product chain. To what extent is it convenient to produce the product within the own firm and under what circumstances does it become necessary to delegate functions outside the firm? This question of *make* or *buy* is crucial for the economic efficiency of the firm. Full vertical integration creates the advantage of not having to depend on the power of delivery firms and of being able to internalise the transaction costs associated with the bargaining process with these firms. On the other hand vertical integration creates internal bureaucratic costs that are inherent to the adjustment of different production functions within the firm. Hence the decision to integrate with up- or down-stream firms depends upon the balance between transaction costs and internal organisational costs (Porter 1985). It is often more efficient to arrive at certain forms of vertical co-ordination which, ultimately, depend on the nature of the contractual relationships a firm is able to create with other firms.

Horizontal relationships with similar firms and the geographical location of the firm has been dealt with by Porter in terms similar to those used by authors analysing the theory of economic districts. In addition to the reduction of transport and infrastructure costs, which were the basis of Weber's (1928) theory of localisation, Porter stresses the relevance of the local cultural norms, values and tastes that may influence the final valorisation of the product.

The application of the proposed three basic firm strategies to the analysis of firm behaviour proposed by Porter is particularly interesting. The

option to adopt either cost reduction, product differentiation or focalisation to ensure a competitive market position has important consequences as far as combining the different cost determinants with any degree of consistency are concerned. Product differentiation involves costs that have to be compensated by a better valorisation of the products on the market. The strategy of focalisation rises firm costs still further, and puts heavier, higher conditions to the final selling price, in order to cover the extra costs. The concepts developed by Porter can thus be considered as highly valuable in analysing the behaviour of firms inserted in the different product chains.

Closely related to the analysis of economic districts is the influence exerted by local institutions on a firm's costs. The welfare economics concept of economic efficiency relies upon the concept of the best allocation of scarce resources, but does not take into account the influence institutions may have on the level of economic efficiency. It is quite evident that environmental legislation based upon command and control measures will involve the firm in either heavier or fewer costs depending on the severity of its measures. Although this may be interpreted , in neo-classical terms as an internalisation of negative externalities in the firm balance, the theory does not concern itself with the dynamics of the institutions (Romano 1995). It treats them as static and exogenous to the problem of optimising the firm resources. A promising way of approaching this problem has been offered by Bromley (1989). He stresses the fact that an explanation of socio-economic change that is simply based on efficiency is 'tautological'. The theory of property rights (Demsetz 1967) falls into the trap of circular reasoning when it states that a change of institutional setting is a result of a change in efficiency. This is to forget that efficiency levels depend on the institutional structure that decides the entity and meaning of costs and benefits that economic agents have to take into consideration. In this way Bromley arrives at an authentic endogenisation of the institutional setting.

Applying the concepts developed in this introduction we will address the question of how the Parmigiano-Reggiano system succeeds in maintaining its original, distinctive characteristics and what internal resistance is developing against external forces attempting to convert the system to a more conventional dairying system. The study will describe how a specific technological development is being sustained and where the system is at risk of being dragged along the path of a more globalised development. Particular attention will be given to the tension between the implications of its large market share and maintaining a production process anchored in a centuries-old tradition.

The second chapter of this study describes the origin and the long history of the production techniques associated with Parmigiano-Reggiano. The historical context must, of course, be considered. Sources show that nine hundred years ago Parmigiano-Reggiano was well known. The historical analysis presented in this chapter follows the evolution of the production techniques associated with the cheese over time and shows it has not always been attached to the same technologies. Many crises had to be overcome both at the level of market and production.

Chapter 3 deals with the specific features of the cheese-making process and the essential role of the artisan techniques employed by the cheese-maker are emphasised. The use of raw unpasteurised milk to produce a cheese that takes eighteen months to ripen puts considerable pressure on the capacity of the cheese-makers. They have to combine the different milk qualities in precisely the right proportion otherwise the cheese will not successfully withstand the long ripening process. The final quality of the cheese depends on the local human factor – the cheese-maker.

Chapter 4 examines the natural factors in the area where Parmigiano-Reggiano is produced. Climate and soils are described and the influence they exert on the crop rotation patterns and crop production techniques are discussed. These natural factors create the framework within which different forage crops mature. Whilst in many ways they favour the cultivation of specific crops such as alfalfa, they limit the expansion of crops like maize. Various maps illustrate the large diversity of crops present in the Parmigiano-Reggiano production area, a factor that affects cheese quality.

Chapter 5 analyses the production structure of the dairy farms, the cheese dairies and maturing firms. The main characteristic of the firms involved in the system is their small size. Whilst there is scale enlargement in the Parmigiano-Reggiano production area, it follows a different rhythm to that typically found in industrial dairy systems.

The evolution of the Parmigiano-Reggiano cheese market and patterns of consumption are looked at more closely in Chapter 6. Here the significant role of Parmigiano-Reggiano on the Italian cheese market emerges very clearly. The cheese is entrenched in the eating habits of the great majority of Italians. The fierce competition with Grana Padano, its main competitor, indicates the importance of maintaining an adequate and sufficient quality 'distance'.

Chapter 7 discusses the institutional system and the behaviour of the institutions associated with Parmigiano-Reggiano production. It stresses the important way these institutions influence the behaviour of the economic actors in the chain. They constitute a part of the production system and no clear understanding of the economic performance of the various actors in the Parmigiano-Reggiano system can be obtained without an analysis of their specific functions. This study treats these institutions as being endogenous to the production system. Research centres determine the boundaries of technological development, but at the same time are involved in the development of new technologies that may possibly be compatible with the system.

The process of technological development is analysed in detail in Chapter 8. After a discussion of the current production techniques and their inherent specificity, the tension between the production regulations as laid down by the Consortium and the development of new technologies proposed to the dairy farmers is examined. The debate centring on which technologies should be forbidden and which should be allowed is then developed more fully. Although natural and human factors set boundaries to the system's specific development path, within this space local actors and institutions are able to manoevre in the pursuit of their various objectives. The extent to which the objectives of individual firms may conflict with the broader objectives of the Parmigiano-Reggiano system, that is to maintain the distinctive characteristics of the cheese in order to remain competitive with other dairy systems, is examined more closely.

Chapter 9 looks at the economic behaviour of the dairy farmers, the cheese-makers and those who chair the co-operative cheese dairies. Drawing on a sample of 93 dairy farms, an analysis is made of different farming styles and the extent to which these adhere to the Parmigiano-Reggiano system. The strategies and objectives of some farmers may conflict with the overall system objective and this may be reflected in the degree of loyalty to the system particular during periods of price crises. The cheese dairies also reveal quite different patterns of behaviour. The analysis presented is based on 115 interviews conducted with cheese-makers and cheese dairy chairmen. The sample represents some 18 percent of the total number of cheese dairies following the Parmigiano-Reggiano system. The degree of integration in the up and downstream stages of the chain can vary considerably and provides an indication of how the dairies operate on the market. The cheese maturing firms and wholesalers constitute the final link in the chain. Their market strategies vary according to their market share. This in turn has repercussions for

their relationship with the cheese dairies. Chapter 9 shows that the considerable rigidity in the supply of Parmigiano-Reggiano is overcome to some extent by differentiating among the various cheese qualities on the market.

Chapter 10 begins with an analysis of the technical and economic efficiency of Parmigiano-Reggiano dairy farms. Using the accounting data from 77 dairy farms located both on the plains and in the mountain areas where Parmigiano-Reggiano is produced, a comparison is made between the milk production costs of Parmigiano-Reggiano milk and milk destined for industrial processing. Three-year averages are used to moderate year-specific effects. The differences in technical and market efficiency between the two farm types are reflected in their farm balances. From these analyses conclusions can be drawn about the economic viability of Parmigiano-Reggiano dairy farms. The economic analysis is then extended to the cheese dairies where accountancy data from the 115 cheese dairies are analysed to establish processing costs. A high degree of variability among cheese dairies is confirmed. However, the analysis shows that beyond a certain size no significant economies of scale can be identified.

Chapter 10 deals with the collective performance of the Parmigiano-Reggiano system. An attempt is made to answer the question to what degree the system can create more employment, especially in the less favoured parts of the production area. Does the price of Parmigiano-Reggiano always cover the higher production and processing costs involved in complying with the special production regulations? Is the system resistant to the market crises that seem to occur regularly? In answering these questions use is made of a territorial income analysis based upon a methodology that uses data from the General Agricultural Census and the biennial Gross Standard Income per agricultural activity and altitude zone used for the farm type classification of farms in the EU.

Chapter 11 goes into the details of the nitrogen balance of Parmigiano-Reggiano dairy farms and the question is raised whether Parmigiano-Reggiano dairy farms are more compatible with their environment than dairy farms not linked to the system. The data set for this analysis consists of accountancy data for 179 dairy farms located in the plains and mountains. Bookkeeping data have been integrated with data collected via a questionnaire. This data combination is basic to a specific methodology and has been developed from Dutch and German farm nitrogen balances published in the 1980s.

Chapter 12 also summarises the various arguments reviewed in the study. The strength and weaknesses of the Parmigiano-Reggiano system are again critically examined and some predictions are made about future prospects. Particular attention is given to the globalisation of markets and the effects this may have on the economic performance of the Parmigiano-Reggiano system. Continuing liberalisation of agricultural markets is leading to increased competition and this means that the Parmigiano-Reggiano system will have to make more effort to remain competitive in both home and export markets. A balance should be found between the need to maintain the distinctive characteristics of the cheese – making it possible to continue to comply strictly with the production regulations – and the need to reduce production and processing costs in order to keep close contact with the market. This last chapter deals with this intricate problem in more detail.

Notes

[1] To many this cheese may be known as Parmesan cheese, but here the Italian denomination will be used, as this is the official name under which the product legally is recognized.

[2] The mix of specific physical, natural and human resources present in a certain area which strongly influences the production techniques of a local product has been denominated in France the '*terroir*' (Allaire and Sylvander 1995; Delfosse and Letablier 1995).

[3] This group of regions has been called by Bagnasco (1977) the Third Italy, with respect to the north-west (large industries) and the South (structurally backward).

[4] Some examples of the district of ceramics (Sassuolo), textile (Prato, Carpi), furniture (Cerea, Oderzo, Poggibonsi), stockings (Fermo, Montecatini), glasses (Belluno).

2 The History of Parmigiano-Reggiano Cheese*

The first explicit historical reference to the cheese now officially called Parmigiano-Reggiano is to be found in a source outside its production area. It is an entry made in the purchasing ledger kept for the Commune (Local Council) of Florence's Priors' Refectory in 1344. The name used in the entry is 'Parmigiano'.

The second oldest reference is very well known. The writer is Giovanni Boccaccio, one of the fathers of the Italian language. In 1348 he wrote in the *Decameron* 'in an area called Bengodi ... there was a mountain of grated Parmigiano cheese ...'. Given the cosmopolitan nature of Boccaccio's readership and the fact that he was a famous writer with an audience that extended well beyond Italy, it is reasonable to suppose that the subject matter of this quotation – Parmigiano cheese – was well known. It would be quite understandable if a 'minor' author, writing for a locally based public, refer to 'grated Parmigiano'. He could feel safe in the knowledge that his reference would be readily accepted and appreciated. However, Boccaccio readers were far from provincial and he wrote for a wider public. If he chose to heighten the description of the gastronomic delights enjoyed by his merry company with a specific reference to grated Parmigiano, it means that his readership must have known this type of cheese well and have understood how it was normally used.

Thus, even in the mid-fourteenth century the predecessor of present day Parmigiano-Reggiano was already part of a gastronomic culture that extended far beyond the limited frontiers of its production area. The fact that these documents date from the fourteenth century has lead to a universal acceptance by historians of Parmigiano-Reggiano that its origins must date from somewhere in the mid-thirteenth century.

* This Chapter is based on research carried out by Mario Iotti 'Storia del Formaggio di Grana 'Parmigiano-Reggiano' (1200-1990)', ('the History of 'Parmigiano-Reggiano' Grana Cheese (1200-1990)', Modena 1991. Reference has also been made to the following works: Enzo Dieci 'Parmigiano-Reggiano, Viaggatori Stranieri e Storia Padana', ('Parmigiano-Reggiano, Foreign Travellers and History of the Po River Valley') Reggio Emilia, 1980 and AAVV 'Il Parmigiano-Reggiano. Un Simbolo di Cultura e Civiltà' ('Parmigiano-Reggiano. A Symbol of Culture and Civilization'), Reggio Emilia 1992.

It is likely that it would have taken about a century before such a wide spread reputation could have developed. In the absence of written documentation relating to Parmigiano-Reggiano production prior to the quotations referred to above, historians have had to rely on logic and deduction. It is now universally accepted that the first to produce 'Grana' (Parmigiano) cheese in the plains south of the River Po were the Benedictine monks established in the area. There are several factors that support this hypothesis.

1 In the period preceding the land reclamation carried out by Benedictines in the late Middle Ages, the number of cattle kept on the lands to the south of the Po were quite small. They were kept as working oxen. Oxen were of considerable value in an agricultural system based on cereal and leguminous grain production where the land had to be ploughed each year.
2 Until the late Middle Ages, local cheese production centred on the Val Taro in the Parma mountains. Its history extended back to the early days of the Roman Empire. Cheeses were made entirely from sheep's milk, for sheep had been the principal source of milk in these areas for centuries.
3 Before the Benedictine settled in what is today the Parmigiano-Reggiano production area, there had been no herds of cattle large enough to support the production of even a small amount of 'Grana' cheese[1]. There is no evidence that any form of collective organisation in the form of turning cheese dairies existed earlier, although such systems had already developed in Alpine regions.
4 The Benedictines initiated extensive land reclamation schemes in unproductive marshy regions and in particularly in the alluvial areas beside the Taro, a river that flowed from the Apennines in the Province of Parma. This, combined with forest clearance, enabled them to convert the extensive gifts of land received from both private citizens and from the civil and religious authorities of the time into productive farmland. The land reclaimed in this way was used to grow the crops of the day (cereals and leguminous grain), and on the plains to the south of the Po permanent meadows or pastureland were created. These provided the support necessary for the development of the large herds of cows used for milk production.
5 The techniques used for processing the milk when making Grana cheese involved heating the milk twice in processing vats. This required more knowledge than could be gained from practical experience. It was only in the setting of the Benedictine abbeys that it would have been possible to develop the sophisticated techniques used. They were derived from an attentive and meticulous observation

of the bio-chemical processes that occurred as the cheese was processed and ripened.

6 Finally, it should be remembered that in areas other than Italy, Benedictine monks had also showed a particular interest in producing different types of cheeses. In the twelfth century the Cistercians perfected these processes further. Many typical European cheeses are named after Benedictine monasteries of the period: Bellelaye, Chaligny, Beval, Briquebec, Champaneac, Chambarand, Citeax, Cluny, Conques, Igny, Laval, Mont-Des-Cats, Munster, Saint-Maur and Tamié.

In the thirteenth century, Emilia and Lombardy, was known as Longobardia. There were many Benedictine granges[2] in the region. These were generally sited along the route of the ancient Via Emilia and the monks had a preference for sites near streams and rivers. Indeed, the criteria used in the selection of sites reflected a need for easy of communication and the possibility of exploiting water resources in the interests of irrigation.

Documents confirm that the 'Grana' cheese, produced on the south side of the River Po, was known from its earliest days as 'Parmigiano' (Florence 1344), Parmigiano (Boccaccio 1348), Parmensis (Bologna 1351). There can be no doubt that the area of origin was Parma. This area fell under the ecclesiastical jurisdiction of Parma and included all the land from the west of Reggio Emilia to the east of Fidenza. Today this area includes the western part of the Province of Reggio and almost the entire Province of Parma (with the exception of a small strip of land to the west along the border of the present day Province of Piacenza).

The fact that in Renaissance times the production of Grana Parmigiano was documented in the areas that bordered this region does not detract from the theory that Parma was the region of origin. Probably, as the market for Grana developed, a kind of 'dragging' effect took place with production spreading beyond its 'homeland'.

The technique of double cooking milk evolved with Grana Parmigiano. First milk was cooked at a moderate temperature, and then cooked again at a much higher temperature. Between the two treatments rennet was introduced and the curd was cut into small pieces. In the old days, a branch of hawthorn was used to slice through the curd. Before double cooking was introduced cheese was made by heating milk once at room temperature.

There were no innovations in the salting and ripening of cheese. These were the same techniques as had been used for centuries to produce sheep cheeses that required a long period of ripening. The subsequent history of the Grana production in the area to the south of the Po has inevitably been conditioned by the political, economic and social history of the region over the centuries. The fourteenth century was marked by outbreaks of plague and famine that severely affected the agrarian economy of the region. The area was also the setting for the many clashes that occurred between the armies of the warring nobles of northern Italy. The Emilian countryside provided a 'natural' battlefield for these conflicts and with an already low level of agricultural production it was particularly vulnerable to the depredations of hungry, marauding troops. It was only with the return of the d'Este family to Reggio Emilia in 1409 and the coming to an end of the Terzi family's rule in Parma in 1411 that a period of relative tranquillity returned to the region. The monasteries fostered agricultural production and gradually, under their influence and that of a number of landed gentry and important merchants who had accumulated substantial fortunes in commerce, agricultural output gradually increased.

The role of the Benedictine monks in the agriculture of Emilia and, in particular, in the production of Grana cheese, declined in importance during the next three hundred years. In 1783 the then Duke d'Este expropriated the lands belonging to the order. Expropriations continued throughout the Napoleonic period and in 1867, with the emergence of the new Kingdom of Italy, the last Benedictine and Cistercian property was taken over by the state.

During the sixteenth and seventeenth centuries the production of Grana cheese in Reggio Emilia expanded and was consolidated. From 1700-1800 new cheese dairies were set up. These small businesses were developed by members of the bourgeoisie and the better-off section of the small agrarian nobility. They remained accessible to the '*latteroli*' as the local farmers were know in local jargon. Improvements in the fortunes of dairy farming in Reggio Emilia can be traced back to the eighteenth century when much previously fallow land was converted into meadows where rotation was practised and clover or alfalfa planted. This practice became so widespread that, in the course of the eighteenth century, the irrigation needs of the new meadows gave rise to considerable competition for water and disputes over water rights.

As far the social organisation of the production was concerned, the last few decades of the eighteenth century saw the emergence of the institution known as the turning cheese dairy. Each member of the organisation had a turn at producing cheese. The amount of time allocated

to each member in the role of cheese-maker was strictly proportional to the quantity of milk delivered. This production system had been widespread in Alpine districts since the Middle Ages. Alpine conditions were more favourable to the development of turning dairies because of the lower quantities of milk required for making Alpine cheeses. Turning cheese dairies persisted into the mid-nineteenth century. They made it possible for the smallest producer to process milk into Grana cheese and as a result it stimulated the growth of this section of the community.

The structure of production and social organisation was such that Grana cheese production became well established and spread throughout the Reggio region. As a result, the region was able to maintain a substantial level of production in the early 1800s. The epicentre of production was the area immediately to the West of Reggio Emilia itself - the present day municipalities of Bibbiano, Cavriago, Montecchio, Campegine and S. Ilario. In Modena, the ducal seat of the Este family, production of Grana was relatively late and significant developments only started in the second half to the end of the nineteenth century.

The development of Grana production in the Parma area, however, was a different story. In 1731 the Duchy of Parma passed to the Borboni family when the Farnese line died out. During the last years of Farnese rule extensive deforestation in the Apennines had resulted in a reduction in the amount of water available for irrigation. Agriculture in the region had also been impoverished as a result of the continuing forays of various warring armies. The Borboni family introduced significant changes when they took over control of the region. Their economic policies, characterised by heavy taxation, exacerbated the negative trends both in the production and sale of Parmigiano cheese. It was in this climate, in the early 1700s, that a group of merchants emerged within the Duchy of Parma and the area close to Piacenza. They traded in the Grana cheese that came from the area around Lodi on the other side of the Po and in the cheese that was produced locally. The Lodi cheese was also known as Parmigiano. This opportunism would perhaps today be recognised as a keen marketing strategy. Cheese production was the first victim of Borboni taxation. In 1750, a decree was issued forbidding the export of locally produced butter beyond the Duchy of Parma, an area that included both Parma and Piacenza. In 1751, a customs duty was imposed on imported cheeses and their export beyond the Borboni territory was forbidden. In 1765 a production tax was imposed on locally produced cheese. Producers had to obtain a special licence for the sale of Parmigiano. A licence was even necessary if the producers intended to consume it themselves. These restrictive laws struck hard at the production and sale of Parmigiano in the Duchy[3]. Finally, the decree that established large areas of hillside and

plain as hunting reserves also had an impact because the area available for the cultivation of forage crops was reduced. By the early 1800s, as a result of these measures, Grana cheese production in the Duchy of Parma was insufficient to satisfy internal demand. The situation persisted until 1860, when the Duchy was annexed to the new Kingdom of Italy.
On the other side of the Po, in the countryside around Lodi, production and sale of Parmigiano profited from the crisis in Parma. From the end of the sixteenth century, Lodi butter and cheese production developed rapidly mainly as a result of the abundant water resources available for the cultivation forage crops. In Napoleonic times production was very high in this area, whereas in Parma under the Borboni regime, there were hardly any merchants or tradesmen selling Grana cheese. Lodi producers dominated the production and sale of butter and Grana cheese in this period. The cheese continued to be known by the prestigious name of 'Parmigiano'. It is interesting that the Grana cheese produced in Reggio Emilia was called 'Lodigiano' right up to the beginning of the nineteenth century. It only took on the name 'Reggiano' in the late 1880s.

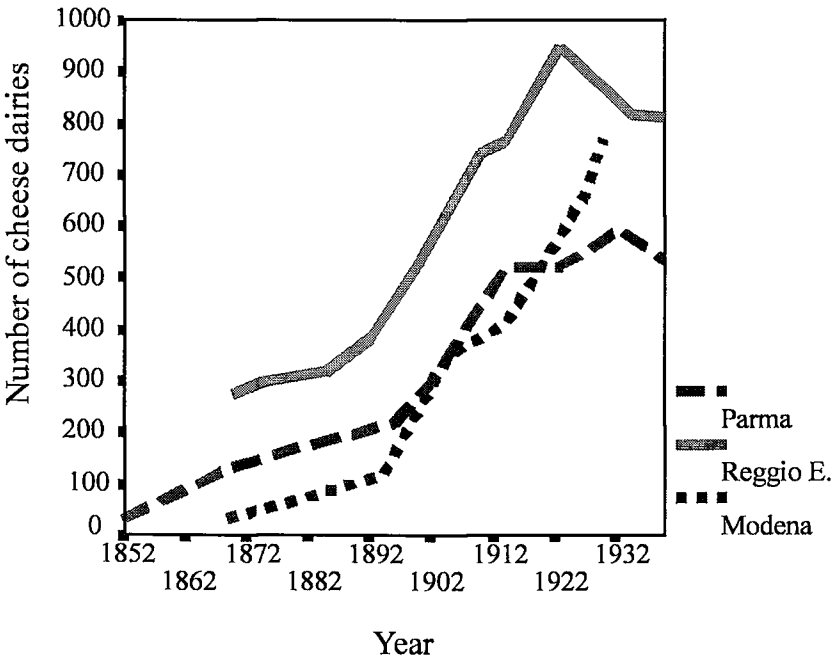
Serious quality problems were associated with the growth of production in Reggio. The problem was highlighted by the fact that a large number of cheeses went to waste. The crisis in the turning dairy system can be attributed to the deterioration in quality. The problem was a source of regular disputes between the suppliers of milk and the cheese-makers. This discontent was fuelled by mutual distrust and accusations of fraud on the one hand, and of a lack of professionalism on the other. The culture of working together in associations had yet to develop. Farmers did not consider cheating the dairies to be unacceptable behaviour. Cheese-makers on the other hand, were the only ones who knew the secrets of cheese-making and so they were able to mislead the suppliers about the quantities of cheese actually produced as well as the amounts lost because the necessary skills were lacking. The turning dairy system was unable to survive under conditions of continuous conflict. Handicapped as they were by the absence of a strict code of behaviour, they were gradually overtaken by cheese dairies that were run as commercial businesses. These dairies restored cheese-makers to their ancient role as artisan entrepreneur who bought milk from the '*latteroli*' (milk suppliers) of the surrounding area themselves and then took the risk of processing the milk and selling it as cheese. By 1880 these change had permeated the region to the south of the Po.

However, despite these changes there were still problems in the relationship between cheese makers and farmers. The high risk of technical (wasted produce) and financial failure together with a saturation market resulted in a fall in milk prices on both sides of the Po. Some

reactions were extreme and resulted in a movement from Grana to Emmenthal, Gorgonzola and Stracchino. By the early 1880s product diversification was beginning to appear and it is a trend that was destined to continue up to the present day. In Emilia, however, this reaction was confined to one isolated example (Bibbiano in 1881) and there were no further repercussions.

It was in this context too that efforts to improve the levels of professional skill among cheese-makers themselves. For centuries such skills had been founded on the empirical skills handed down from one generation to the next. In a period of rapid growth, the delicate and slow mechanisms involved in such a system of skill inheritance began to break down. Too many so-called 'cheese-makers' entered the trade with largely improvised skills. The graph below shows the marked increase in Grana producing cheese dairies in the provinces in Emilia Romagna included the present day Parmigiano Reggiano district.

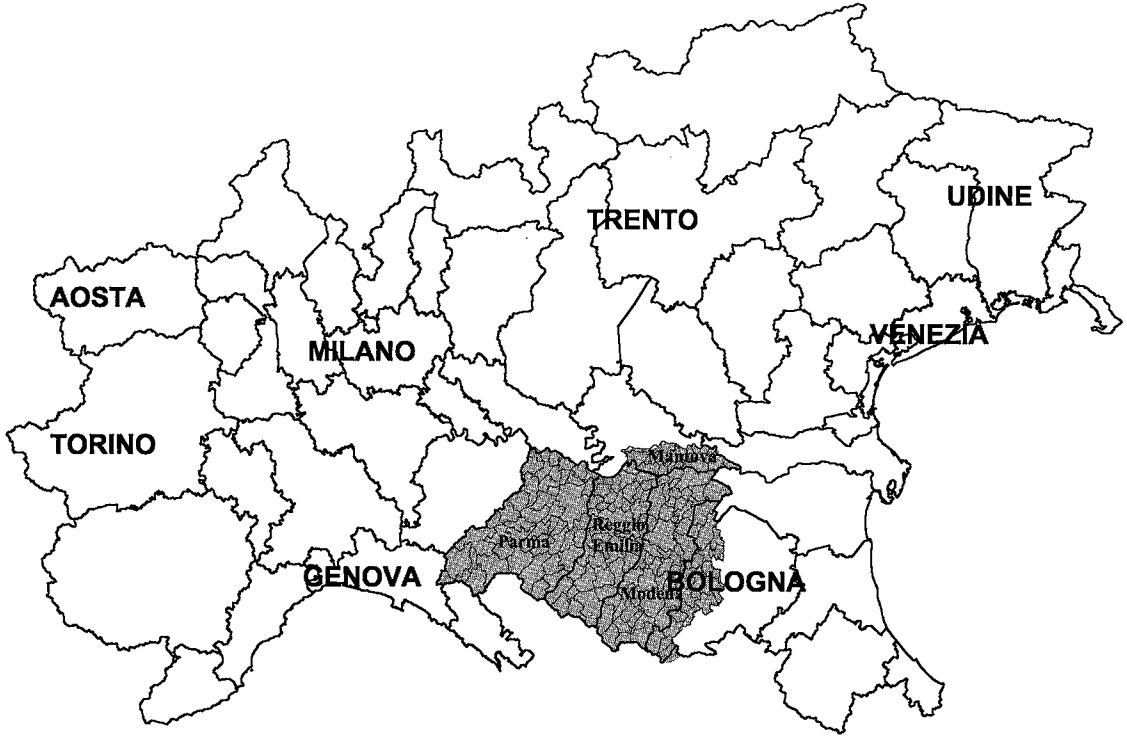
Figure 2.1 Evolution of cheese dairies in the Parmigiano-Reggiano district



Source: Elaborated on data published by Iotti (1991)

The rapid increase in the number of cheese dairies was more than matched by the quantity of milk processed and Grana produced. This phenomenon was particularly evident in the period 1890-1910 and was to continue unabated until the beginning of the Second World War.

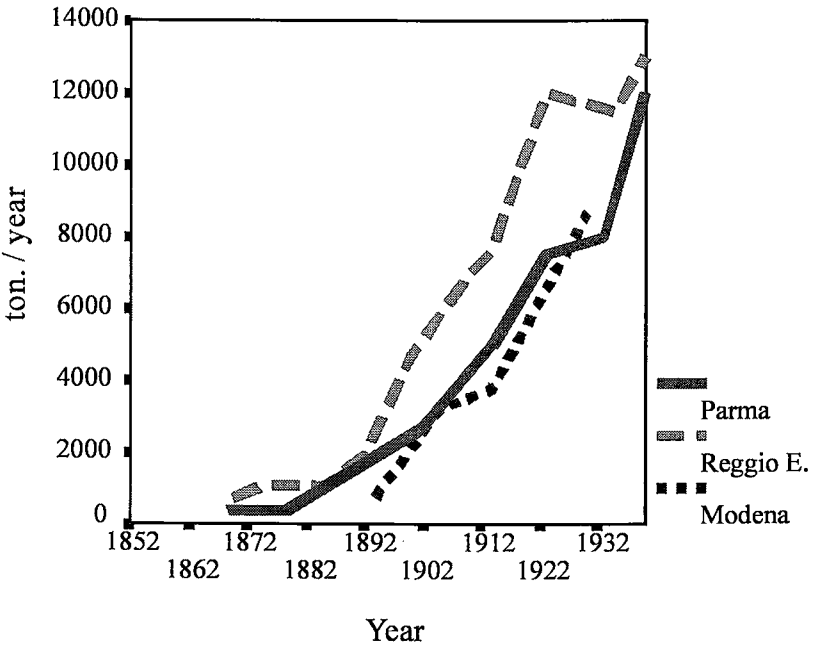
SIZE AND LOCALISATION OF THE PARMIGIANO-REGGIANO PRODUCTION AREA



Elaborated by: CRPA S.p.A. - Reggio Emilia

The most important aspect of this development was the creation of technical institutions on whose curricula agronomy was a particularly important subject. These courses were accompanied by more attention being paid to professional training for those working in agriculture and the first initiatives towards setting up an advisory service. This was also the period when scientists such as Carlo Rognoni and Antonio Bizzozzero in Parma and Antonio Zanelli, Pellegrino Spalanzani and Giuseppe Notari in Reggio Emilia rose to prominence.

Figure 2.2 Evolution of the production of Parmigiano-Reggiano cheese



Source: Elaborated on data published by Iotti (1991)

The most immediate and appreciable effect of the union between agrarian science and the production of Grana cheese was not the provision of more professional training for cheese-maker. For another century they were destined to follow a training based exclusively on empirical principles. From an historical point of view by far the most important event in this period – and one with clear practical consequences – was the introduction of the use of triggering whey (1890) as a means of reducing waste production. Before this innovation the percentage of production going to waste had varied from 20 percent and 50 percent.

The technique was introduced by Notari, who would nowadays be described as a cheese-making technician who had first hand experience of working as a cheese maker. His innovation was the fruit of many years of observation and experimentation. His technique was gradually perfected and became an established part of process of making Grana cheese.

The years between the end of the nineteenth century and the beginning of the twentieth saw the appearance of the first cooperative dairies. This way of organising the production of Grana went through later modifications, but came to be a characteristic feature of production in Parmigiano-Reggiano. The important thing inherited from the old turning dairies was the spirit of working together. They were organised by farmers to defend their negotiating positions against the cheese-making businesses who continued to bear the full risk of the cheese-making process and who were responsible for finding sales outlets for the finished Grana. As early as 1910, the cooperative dairies had already started to take over milk processing and the marketing of the finished Grana. This way of working continues to the present day.

The continuous growth in production raised problems for the organisation of the ripening phase. From early times, the relatively small stocks of finished Grana were ripened within the dairies where the cheese was made and they required only a limited amount of space. Indeed, in all recorded cheese dairy leasing contracts, the cheese-maker is charged with carrying out the cheese ripening process over a period of two years. With the production explosion at the turn of the nineteenth century, it was necessary to build new storehouses for the ripening cheeses. The continuous growth in stocks kept in store required an increasing amount of capital investment. It was extremely unlikely that private individuals or groups of farmers within the cooperative dairies could have afforded such an outlay of capital.

For these reasons a progressive and irreversible split occurred between the tasks of processing and ripening Grana cheese. At the beginning of this century the first great store-houses for ripening Grana cheese began to appear in Parma, Reggio and Modena. The owners of these buildings were local banking institutions who granted credit facilities to the cheese owners against the security of the cheeses being ripened in the storehouses. The banks also took over the care of the cheeses during the ripening phase, and charged the cheese owners for these services. The banks, however, did not take over the risks associated with the ripening process. As ripening costs grew and became another risk associated with the production of Grana, many cheese dairies chose to limit their production to processing milk into unripened Grana and were only

prepared to take responsibility for the first year of the ripening process. The cheese was then sold to the wholesalers who, in order to complete the ripening process, either sent it to the store houses belonging to the bank or ripened it themselves in their own buildings. The first category came to be seen as wholesalers, whereas the second category were seen as ripeners. Both categories maintained a certain distance from each other. From an historical perspective however, this was the period that saw a permanent division emerging between the commercial side of the Grana industry and the manufacturing side. A clear distinction also emerged between the work forces involved in commerce and manufacture. This was not the first time in the history of Grana cheese production that such a distinction had arisen to the south of the Po, but the distinction had never been so sharply defined.

Our discussion up to this point has concentrated on a description of eight hundred years of Grana cheese production in Emilia and the Lombardy low lands to the North of the Po. The double name Parmigiano-Reggiano, however, the explicit and universally recognised combination that is now both unquestioned and famous has its origins in the twentieth century. The story began in 1895 when the Milan Chamber of Commerce unilaterally declared that Parmigiano could only be produced in the Province of Milan that included Lodi. The Parmigiano produced in Emilia must now to be called 'Reggiano Giallo' ('Yellow Reggiano'). This provision would seem strange were it not for the fact that in former times traders based in Parma had been given the name Parmigiano even to the Grana produced in Lodi. The reaction of the Chamber of Commerce in Parma however was immediate. Only Grana produced in the province of Parma or Reggio could be called Parmigiano. This included in particular the lands of the old Duchy of Parma, ruled first by the Farnese, then by the Borboni families and finally by Maria-Luisa of Austria. Reggio's Chamber of Commerce in turn decided to call the Grana produced in its province Grana Reggiano. Legal action followed and resulted in a final judgement by the Court of Cassation in Turin in 1899 which denied the Milanese the right to call their cheese Grana Parmigiano.

The 'war' between Milan and Emilia was quickly followed by a conflict between Parma and Reggio. In 1904 Parma wanted to impose the use of the single name Parmigiano thus denying the legitimacy of the name Parmigiano-Reggiano which was beginning to attain recognition in the commercial world. Reggio reacted by expressing its agreement with the position previously taken by Milan, even though the courts had declared against it. Therefore, until 1909 Parma called its Grana Parmigiano and Reggio gave its product the name Reggiano. This short sighted parochialism continued with ups and downs until 1934, surviving the

crisis brought on by the First World War up to the economic recession of 1927-1934. Indeed, it was precisely the crisis of the Great Depression that served to attenuate the fierce rivalry between the two Emilian provinces. All operators within the production cycle realised that their interests would be better served if they joined forces to defend their product both at a national and international level.

The year 1934 marked the official birth of the name Parmigiano-Reggiano and coincided with the formation of the *Consorzio Volontario Interprovinciale del Grana Tipico* (The Voluntary Interprovincial Consortium of Typical Grana). This organisation also introduced the brand name that was destined to continue unchanged up to the present day. It was also the first time in Italy that a formal organisation had been set up to protect a cheese. It should be added that, in creating this consortium, the producers of Emilia had rejected the proposal coming from Milan suggesting that the whole Italian production of Grana should have a national brand name. In 1934 the Consortium defined the geographical limits of the Parmigiano-Reggiano production area to include the Provinces of Parma, Reggio and Modena together with the region to the South of the Po in the Province of Mantua. Only in 1937 did a commission from the Ministry of Agriculture, charged with confirming the geographical extent of Parmigiano-Reggiano production, include a small strip from the Province of Bologna, to the west of the River Reno. This geographical definition has remained to this day.
Following the deep crisis brought on by the Second World War, the Voluntary Consortium of Typical Grana that had virtually gone out of business, re-organised itself in 1954 on a new constitutional basis. It took the name that is still used today: *Consorzio del Formaggio Parmigiano-Reggiano* (Consortium of Parmigiano-Reggiano Cheese). The production area, trademark and governing regulations remained unaltered with respect to the constitution of 1934, while the new constitution incorporated the national legislation concerning the designation of origin and the protection of national (Italian) cheeses, passed in 1954. The more recent history of Parmigiano-Reggiano does not include any events that have brough radical change to this organisational and institutional picture.

Parmigiano-Reggiano was put in a position of almost complete invulnerability not only by its centuries-old history but, more particularly, by the fact that all the forces involved in its production were able to join together. By 1934, they had created a strong formal organisation well before any other typical Italian cheese had been able to do so. This invulnerability meant Parmigiano-Reggiano emerged unscathed from the legal difficulties surrounding the concept of typicality and protection.

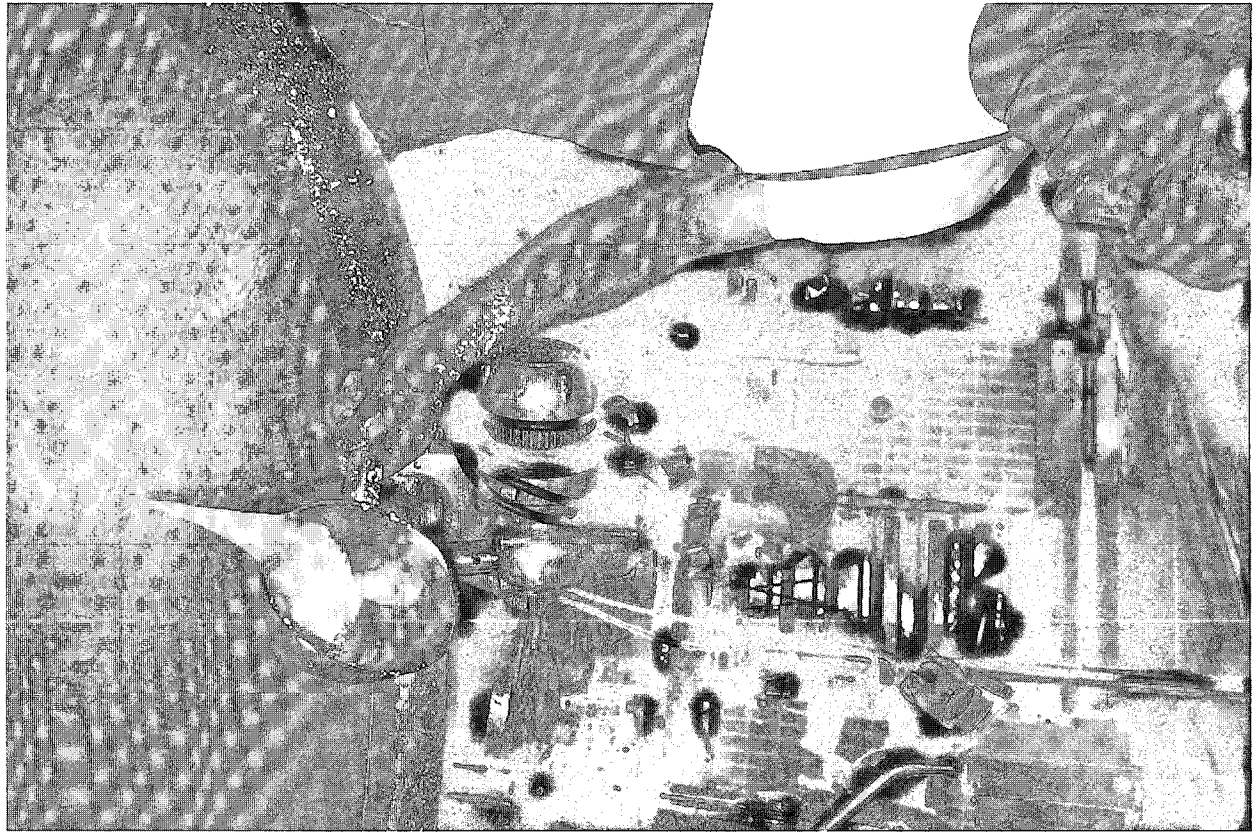
From the moment that such problems emerged on the international scene at Stresa in 1951, Parmigiano-Reggiano's position was never questioned.

Notes

[1] To obtain a Grana cheese weighing 20 kg at least 300 kg of milk would have been needed. Once it is realised that in the late Middle Ages annual production for one cow did not exceed 800 kilo (with an average daily production of 3 kilo and a maximum of 10 kilo) one Grana cheese would have required the joint production of a minimum of 50 cows, but more likely, that of 80-90.

[2] A 'Grancia' (grange) was a monastic organisation but economic in nature, dependant on the Abbeys or Priories for its existence, in the form of a settlement providing shelter for the agricultural labourers and for the livestock. It also acted as a depository for agricultural implements and as a store for food stocks and commodities.

[3] The Duchy of Parma under the Borboni included the lands now within the confines of the present day Provinces of Parma and Piacenza, together with a small part of what is now within the borders of the Province of Reggio Emilia. The geographical extent of the Duchy's lands demonstrate extremely well how the customs barriers set up by its government had such deleterious consequences on the local production of Grana Parmigiano. Indeed, it was only necessary to move to the East (Reggio) or to the North-West (Lodi) to be outside the Duchy's frontiers.



3 The Production Process

3.1 The production regulations

The milk processing techniques used to produce Parmigiano-Reggiano are rooted in an ancient tradition that is closely linked to Emilian customs and practices. It is only recently that a formal set of rules has been developed to prescribe correct practice. The principle of recognising designations of origin for cheeses in Italy has been introduced by the National Act no 125 of 1954 following the Convention of Stresa of 1951. Standards for Parmigiano-Reggiano production were then defined legally for the first time in Presidential Decree No. 1269 of 30 October 1955. These rules have been supplemented by the cow-feeding production and quality branding regulations issued by the Consortium of Parmigiano-Reggiano cheese. These are constantly being updated as new technological developments take place.

The rules that define the characteristics of the cheese production techniques concentrate mainly on product description. The procedures for processing and ripening Parmigiano-Reggiano cheese are as follows:

1 Parmigiano-Reggiano is defined as being a half-fat, hard, fully cooked cheese that is ripened in natural conditions. The ripening phase must continue from the year of production to the end of the summer in the following year. In practice the ripening phase lasts from 18-24 months.
2 Milk is processed once a day beginning in early morning. The milk used comes from the previous evening's milking. This is left in special settling tanks over-night and the fat that rises naturally to the surface is creamed off. Whole milk that arrives from the morning milking is added to it.
3 Anti-fermentation substances are forbidden.
4 Coagulation is initiated by using rennet derived from the stomachs of unweaned calves.
5 Two to three days after the cheese-making process has been completed, the cheese is immersed in saturated brine for a period that varies from 20 days to a month.

The production standard used to define the cheese is as follows:

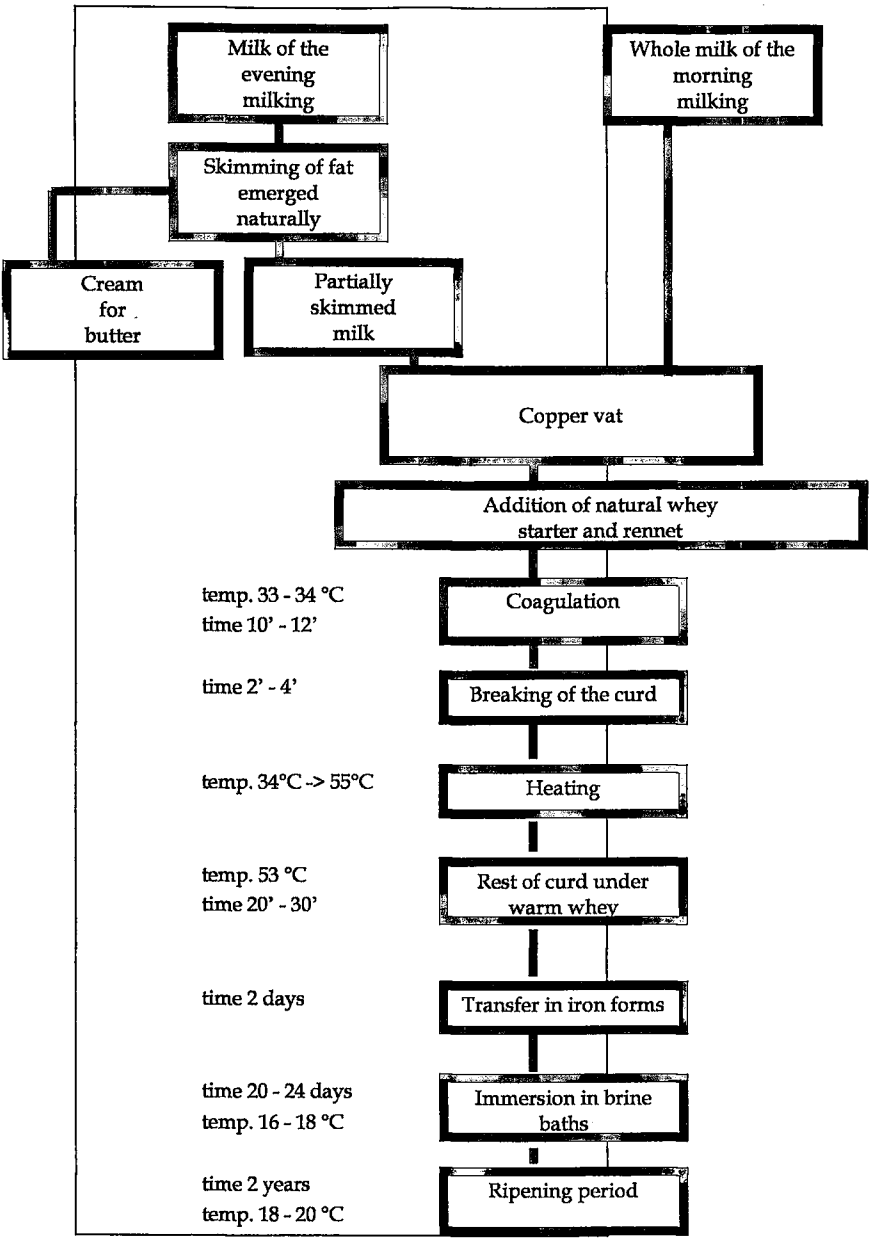
1 The cheese is cylindrical in form. It is 35 to 45 centimetres in diameter and between 18 and 24 centimetres in height. The upper surfaces of the cheese are flat while the base is slightly convex. The weight of a cheese can vary between 24 and 40 kilo.
2 Traditionally in the past the external appearance of the cheese was dark in colour because linseed oil was applied during the ripening phase. With the passage of time this oiling technique has been abandoned in favour of an automated cheese cleaning process. Today the outer rind is yellow-gold in colour, corresponding to the natural colouring of the ripened cheese. The rind is about six millimetres thick.
3 The regulations permit variations of a slightly straw-like colouring for the interior of the cheese. Again, with the passage of time and change in consumer preference, the inside colour of Parmigiano-Reggiano cheese has become increasingly white[1].
4 The texture of the cheese is made up of tiny structured granules[2] and when fractured the cheese breaks into scale-like fragments. When cut, the cheese reveals tiny holes that are just visible to the eye.
5 Parmigiano-Reggiano has a characteristic and fragrant taste. It is delicate but does not 'burn'.
6 The fat content should not be less than 32 percent on a dry matter basis.

These requirements laid down in the Presidential Decree No. 1269, 1955 leave relatively wide margins of tolerance as far as the dimensions and weight of Parmigiano-Reggiano cheeses are concerned. In reality there is considerable similarity in the production techniques of the various dairies. Nowadays, the weight of a ripened Parmigiano-Reggiano cheese varies from 35 to 37 kilo, its height can be between 20 and 22 centimetres and its diameter is usually between 40 and 45 centimetres. A small cheese of 24 kilo could be expected to ripen faster and although it would cost less, its taste would not be greatly appreciated by the consumer.

Presidential Decree 1269 recognises production techniques for the first time in defending the product and its name against unfair competition. This is the main objective of the decree. Actors comply with the rules laid down in the decree because the regulations are based on local, fair and constant uses and the customs of the production area[3].

The standard milk-processing pattern for Pamigiano-Reggiano cheese and for the ripening stage is summarised in Figure 3.1

Figure 3.1 Processing of milk for the production of Parmigiano-Reggiano cheese



Source: Consorzio del Formaggio Parmigiano-Reggiano

The first set of regulations relating to the production of milk for Parmigiano-Reggiano cheese was issued in April 1973 when a specially produced 'Green Paper' was published by the Consortium. This had a binding effect on all milk producers. The Consortium had two objectives:

a To set limits on illegitimate practices and to clearly define which practices were prohibited.
b To provide a technical assistance service for the management of Parmigiano-Reggiano farms.

The Green Paper begins by setting out recommendations of a technical nature that do not differ from or go beyond those that would be found in any dairy handbook on good practices irrespective of the milk's end use. The paper also deals with the way cattle should be fed. The two most significant and distinctive elements here are:

1 The use of silage in the feed given to dairy cows is absolutely prohibited.
2 Preference is given to locally produced forage.

Three forage crops are excluded from the list of permitted food-stuffs: summer ripening sweet sorghum, hybrid sorghum under one metre in height and forage beet and its fresh by-products.

The following types of concentrate are also forbidden: colza, rape seed, mustard, fenugreek, leaves from any kind of tree, wild garlic, coriander, any fruit or vegetable, and sugar beet. The list of prohibited feeds also includes derivatives from any of these that may be obtained through industrial processing. All protein containing flours of animal origin such as those made from fish, blood, meat, feathers or any other abattoir by-products are forbidden. A similar ban also applies to fats and oils of any kind, various seeds, the by-products of rice processing and oil cake made from materials other than flax or maize. Flours derived from rape seed, cotton, tomato seeds, sunflower seeds, tobacco, poppy, palm, olives, almonds and walnuts are all prohibited. Dried vegetables and dried or desiccated fruit of any kind are also excluded as are product derivatives obtained from processing the fermented by-products of the sugar industry, yeast and distilleries by-products.

Maximum percentages on a dry-matter basis or maximum quantities per cow per day have been prescribed for permitted feed ingredients. This long list was published in 1973 and whilst it was intended to have a preventative function, it also served as a guide for the feed industry when it came to preparing special compound feed for Parmigiano-Reggiano dairy farmers. The 1973 regulations provided an official reaffirmation of rules that were far from new to local farmers (prohibition of silage and the

recommended use of forage crops produced within the Parmigiano-Reggiano area). It set a balance, to some extent ahead of its time, between the ever more compromising range of products on offer from the animal feed industry, the future of local livestock farming and the quality of Parmigiano-Reggiano itself. The Consortium in which all cheese dairies are represented in this way has set boundaries within which Parmigiano-Reggiano dairy farmers could operate.

After a first updating in 1989 of the feeding regulations in order to take account of new developments in the animal feed market, recently in 1999 new rules were added to the feed regime:

1 At least 35 percent of dry matter forage must come from the farmer's own dairy farm.
2 At least 75 percent of dry matter forages must come from the Parmigiano-Reggiano production area.
3 Not more than 25 percent may come from outside the production area, and then only from neighbouring regions.
4 The quantity of concentrate in a cow's rations may not exceed 50 percent on a dry matter basis.

These provisions became necessary as the production of milk per cow continued to increase as a result of genetic improvements. There was therefore a serious risk that there would be a too heavy dependence on externally produced concentrates and roughage.

As far as the breed of cow is concerned, Parmigiano-Reggiano production regulations permit any breed to be used to provide milk for cheese making. This tolerance reflects the fact that in the 1950s a substantial number of Dutch black-and-white cattle were imported and, in the 1970s, they seemed to be replacing local breeds completely. Currently, Italian Friesian cows make up the greater part of Parmigiano-Reggiano herds. There are also a substantial number of Brown Swiss cattle. The native breeds – Reggiana and Bianca Modenese – are relatively insignificant when compared to total herd size, although recently the red Reggiana breed has begun to gain importance as a result of support from the Emilia Romagna Region, the Ministry of Agriculture and local market initiatives on the part of some cheese dairies.

In recent decades there has been significant technological development in the European dairy industry. Nevertheless the basic rules for the production and processing of milk for Parmigiano-Reggiano cheese has not changed. This can be partly ascribed to the severity of Parmigiano-Reggiano production regulations, but equally important is the strength of the common culture of those actors involved in implementing these

regulations. Without the mutual social control and the common sense of belonging that these actors possess, it would have been impossible to ensure that everyone complied with the precise details of the Consortium's regulations.

3.2 The production process

In processing the milk for Parmigiano-Reggiano cheese, the human element is critical and exerts a heavy influence on the end product quality. The production process is predominantly artisan. It is the cheese-maker's professional skills that ensure that the various phases in the cheese making process are carried out correctly.
Parmigiano-Reggiano cheese belongs to that group of cheeses that, unlike most industrial cheeses, use raw milk in their manufacture. Furthermore, Parmigiano-Reggiano differs from other cheeses that are based on raw milk in that no additives or substances from outside the production environment are used. Apart from a limited quantity of hay imported from outside the production area, the cheese-making process is based exclusively on products derived from the area of origin.

Fresh milk is extremely complex in its composition. It is therefore extremely fragile and subject to rapid changes. The temperature and humidity of its surroundings exerts an enormous influence on the biological processes taking place within the milk. To give a full description of the processes required for the transformation of this milk into Parmigiano-Reggiano cheese, I start giving a brief indication of its chemical and micro-biological composition. This description is limited to the most essential elements to avoid going into detail on issues that are largely irrelevant to the present study.

3.2.1 Chemical and micro-biological composition of the milk

Milk has specific qualities. These are appropriate to the purposes for which it is used. In industrial milk processing where pasteurisation is involved, it is advisable to use a milk whose protein content consists of heat resistant substances. When raw milk is processed during cheese making, however, a milk with different chemical and micro-biological characteristics must be used.

Table 1 sets out the chemical composition of the milk with the appropriate minimum and maximum levels observed for Parmigiano-Reggiano production. In addition to these chemical components, the raw milk contains millions of microbes of varying shapes and sizes that react with

the solid substances in the milk to transform them into different composites. These microbes are not capable of synthesising the inorganic substances, thus in order to survive and multiply they have to react with the organic substances. Fermentation is the process whereby the organic substances are broken down by the micro-organisms in the milk (Parisi 1954).

Table 3.1 Chemical Composition of milk for Parmigiano-Reggiano cheese

	Average %	Minimum %	Maximum %
Water	88.0	87.0	89.0
Lactose	4.5	4.3	5.2
Fat	3.3	3.0	3.8
Casein	2.5	2.0	2.7
Whey proteins	0.5	0.40	0.60
Non- protein nitrogen	0.1	0.13	0.18
Mineral salts	0.9	0.85	0.95

Source: CRPA-Agrinet

There is an enormous variety of different microbes and each has its own function. For the sake of simplicity, it is possible to divide these microbes into two large groups:

1 The microbes beneficial to cheese-making such as lactococchus, lactobacilli and a series of acid-proteolythics that are part of the original micro-flora of the milk and whose functions support the cheese-making process. These microbes break down lactose to produce lactic acid, giving the correct levels of fermentation acidity to the milk before processing begins.
2 The 'anti-cheese-making' microbes of which butyric and proteolytic microbes have a negative effect when making Parmigiano-Reggiano cheese. Butyric microbes or their spores are protected by a form of capsule and are thus resistant to heat. They too break down the milk's lactose but they produce butyric acid with large quantities of gas, particularly hydrogen. The proteolythics break down the nitrogenous substances transforming them into amino acids and ammonia. These microbes have normally come from sources that are external to the milk itself. They breed particularly in areas that have not been properly cleaned and develop readily on badly conserved foods. One factor that these harmful microbes have in common is that they are often aerobe and require oxygen to carry out their fermentation.

From this description it will be clear that raw milk is an extremely variable raw material. Its chemical and microbiological composition depends on

numerous factors relating to the environment: the type of feed, the breed of cow, the milking system, the lactation phase, the stalling system and the climate. Dairy farmers using their technical skills are able to combine these environmental features to produce the appropriate quality of milk supplied to the cheese dairy. More than a hundred years ago it was stated that 'the art of the cheese-maker lies in promoting the development of the favourable microbes while checking that of the others' (Duclaux 1881).

3.2.2 The cheese-making process

The dairy farmers who produce Parmigiano-Reggiano milk make two deliveries a day. The milk is usually transported in milk churns. The large lorry-mounted containers are only used for milk from large herds. To inhibit over-rapid microbe growth, the milk is chilled briefly to about 18° C.

The milk is normally collected by lorries belonging to the cheese dairies. Sometimes, however, dairy farmers deliver the milk themselves. Once it has arrived at the dairy the milk from the evening milking is first filtered to remove any solid contaminants that may have fallen into the milk. Then the milk is poured into shallow tanks to allow the fats to rise to the surface during the night. Cold water is sprayed onto the under-sides of the tanks to keep the milk temperature between 15 and 20° C. If the milk is too deep only a limited amount of cream will rise to the surface. The shallow tanks ensure that a high proportion of the cream rises to the surface. The large globules of fat agglomerate more quickly, while the smaller globules accumulate later. The cheese-maker is thus able to regulate the amount of cream rising to the surface by adjusting the depth of the milk kept in the tanks. In the morning, the cream floating on the top of the milk is removed.

Storing the milk in tanks for twelve hours serves three functions:

1 The first is relates to the nature of the cheese to be produced. The cheese-making process must begin with a semi-fat milk, where the ratio of fat to casein should range from a minimum of 0.85 to a maximum of one.
2 The second function is that it acts as a kind of milk sanitising process. The cream rises to the surface and when it is removed the amount of bacteria and spores left behind in the milk fall significantly. Through the process of bacterial reduction a large proportion of the microbes and bacteria harmful to the cheese-making procedure are removed along with the fat globules that have risen to the surface naturally. The cream that is taken off has a microbial content of between 20 and 30 times that of the half-skimmed milk.

3 Lastly, the milk in the tanks undergoes a maturation process. The microbes that are beneficial to cheese-making convert the lactose into lactic acid. It is possible to regulate the fermentation speed by making appropriate adjustments to temperature and to the depth of the milk in the tanks. If the milk is deep it produces a rapid fermentation.

Having remained undisturbed over night, the tanks of milk are then placed over the heating vats and the half-skimmed milk is poured into them. The cream that remains is collected and almost all cheese-makers send it on to specialised butter-making dairies.

The cheese-maker decides how much cream must be removed and this depends on the bacterial quality of the milk. If the milk is too 'dirty' it needs to be creamed off more thoroughly than would be necessary in the case of cleaner milk. Once the cream has been removed, the skimmed milk from the previous evening is poured into the vats. Sometimes milk coming from the morning's milking is also set out in tanks to allow a much reduced creaming-off process. Generally though, to save on labour, the morning milk is poured into the vats to be mixed with the skimmed evening milk. The vats are copper, cone-shaped and are sunk into the ground so they are partially under the level of the floor. They have double walls and this space may be filled by steam produced by generators.

Each vat contains a total of 1,200 litres of milk. If the daily milk production of 25 litres from one cow is taken as a reference, it can be seen that one vat can hold the daily production of a herd of almost 50 lactating cows. This means that one vat can be used for several small producers, but that more vats are necessary to deal with production from of a large herd.

The milk from the morning's milking arrives between seven and eight a.m. Immediately after milking, the milk has a natural acidity of between 3.4 and 3.8 SH[4]. Following the gradual fermentation process the natural acidity of the evening milk's rises by a few points and after it has been mixed with the morning milk it will have an acidity of between 3.5 and 3.9 SH. The correct timing for initiating the manufacturing process depends on the degree of acidity of the milk in the vat. The cheese-maker uses visual and tactile clues to decide whether acidity has reached an optimum level. The chemical and microbiological quality of milk received from different producers is extremely variable. A large herd with cows producing high quantities and stalled in a cow-shed with cubicle houses produces milk of a completely different quality than that produced by a small herd of cows tethered in the traditional way. The cheese-maker decides on the combination of different milks from the different suppliers

that should go into each vat, although his choice is limited to some extent by the order in which milk consignments arrive. He knows from past experience how the milk from the different producers reacts in the vats during the cheese-making process. The cheese-maker also marks the different cheeses with the symbol of the different producers. In this way he is able to identify the producer in the event of anomalies or defects that may arise during the ripening phase.

Once the milk is in the vat, the cheese-making process begins. The first move is to add the triggering whey. This comes from the treated milk derived from the previous day's cheese-making. At the end of each cheese making process, the cheese-maker removes a limited quantity of whey. The sample is left to acidify in special churns, a process that depends on the presence of milk enzymes that act on the remaining lactose in the whey to produce lactic acid. If the acidity of the whey is about three SH when a sample is taken, it will have increased to about 25–30 SH after some 18–20 hours. Should the whey be left for a longer period of time, the quantity of milk enzymes would begin to decline.

Adding acid whey at the beginning of the treatment of the milk in the vat enriches the milk with milk enzymes beneficial to the cheese-making process. These act to prevent the spread of microbes that are deleterious to the cheese-making. The triggering whey increases the acidity of the milk in the vat and also introduces a series of enzymes. These enzymes will go on being effective throughout the lengthy ripening stage. The whey also helps create a good structure in terms of cheese texture and water and fat retention capacity (Bottazzi 1979). The addition of whey was an innovation introduced at the beginning of the century and represents an extremely important factor in the successful production of the cheese.

To determine the amount of triggering whey to be added, the cheese-maker has to measure the acidity of the whey and the acidity of the milk in the vat. On the bases on these two values, he then calculates how much whey is needed. At this point the milk is heated to a temperature of about 33° C. and rennet is then added. Rennet is extracted from the fourth stomach of a calf and is sold to cheese-makers by a number of specialist firms. Before he adds it to the milk, the cheese-maker checks its strength. So-called *normal strength* rennet is such that one centilitre coagulates one litre of milk at 35° C in four minutes. The cheese-maker is able to test the coagulating force of the rennet by a quick acting test and from the results of the test is able to decide the amount that must be added. These can vary from vat to vat and from day to day dependant on the characteristics of the milk in the vats and on the quantity of triggering whey added. The coagulation process begins within about ten minutes.

The small casein particles begin to come together under the influence of increased acidity, first as a result of the triggering whey and later as a result of the rennet. Milk which has not been sufficiently fermented or which has been disturbed during its journey coagulates less than normal quality milk. It is by observing the coagulation process that the cheese-maker reaches a decision on how he should proceed with the next phase which involves breaking up of the curd with a curd knife, an instrument characteristic of cheese-making. The curds are broken up into small granules that, at the end of the long ripening process, form the typical granular consistency of the cheese. Deciding on the right moment to break up the curd is particularly important. If it is done too late, the curd is too hard and the whey does not get rid of the granules. If it is done too early, the soft granules are squashed and are not uniform in size. It is necessary to produce a compact and homogeneous mass where the curd granules formed during the breaking up process come together and fuse spontaneously.

The cheese-maker decides whether the granule size is right for the cheese he is making by feeling the milk with his hands. He then decides when the cooking phase can begin. The temperature is increased from 33° C to 55° C. The curd is agitated continuously to avoid any danger of compacting and solidifying at the base of the vat. This process used to be carried out by hand, but nowadays motor-driven machines fixed to the edge of the vat are used to continually mix and agitate the mass of milk granules. The cooking stage lasts about 10 to 15 minutes. During cooking the whey is removed from the granules. The cheese-maker notes the speed at which the whey is removed and decides when the cooking phase should end. He does this by closing off the steam inlet in the cavity between the double walls of the vat. Once the whey has been removed from the granules, they collect and solidify at the bottom of the vat and form a cheese mass. The coagulated mass is left to settle under the whey for almost an hour. Every now and then the mass is pressed down with a spade-like instrument to expel the last of the whey.

When he lifts the cheese mass from the vat, the cheese-maker presses its surface and inspects its compactness. A cheese cloth is left immersed in the whey for several minutes in order to remove the curd from the vat. The curd is cut into two, and the cheeses produced in this way are called twins. They are placed in cheese moulds and at this stage each cheese will weigh about 40 kilo's. They are then placed under a wooden disk that exerts a slight pressure on them and gradually squeezes out what remains of the whey. In the evening the trade mark of origin 'Parmigiano-Reggiano' is pressed onto the base of the cheese.

The craftsmanship involved in the cheese-maker's work and the work of his assistants becomes clear when we consider the various operations they have to carry out. The raw milk varies greatly in composition from one zone to another, from one producer to another and from one day to the next. It is a living product, containing millions of microbes interacting with the different fat particles, casein and lactose present in the milk. Their fermenting action changes the composition of the milk from hour to hour. The cheese-maker's skill lies in his ability to control the fermentation process. The cheese-maker decides the timing of various crucial operations, the quantities of triggering whey and rennet to be added, and the extent of the creaming-off process. He relies on his years of experience and training when making these decisions.

3.2.3 *Salting and ripening*

After several days, the cheeses are placed in aluminium cheese moulds which give them the characteristic Parmigiano-Reggiano shape. They are then immersed in brine. The brine temperature is kept at about 17° C, so that the salt is able to diffuse at the correct speed throughout the cheese. The cheeses are turned once a day and remain in the brine for a period of 15 to 23 days. At this point the cheeses are deposited in store houses for ripening, a phase which lasts for a minimum of 12 months, but normally continues for up to 24 months. During this time, the cheese undergoes a series of chemical, physical and microbiological changes that are influenced by the temperature, humidity and ventilation of the ripening environment. The cheese loses about five percent of its weight during the ripening phase.

The cheeses are kept on long shelves and there are often as many as 25-30 levels. Long, vertical windows are set in the two side-walls of the store houses to create the necessary ventilation. Most plants use artificial air conditioning equipment to control temperature and humidity. The cheeses are cleaned and turned to prevent mould forming on them. Small cheese producers still carry out this process by hand. Others, including the great ripening store houses use machines that turn and clean the cheeses automatically.

3.3 Concluding remarks

The description of the production process shows how many factors influence the final product quality. The key role in the whole process is plaid by the cheese-maker. As will be analysed in further detail in the chapters dedicated to the economic analysis, the economic performance of

the cheese dairies depends heavily on the capacity of the cheese maker in producing high quality cheese. Price differences of cheese which can be significant from dairy to dairy can be attributed in part to the craftsmanship of the cheese maker.

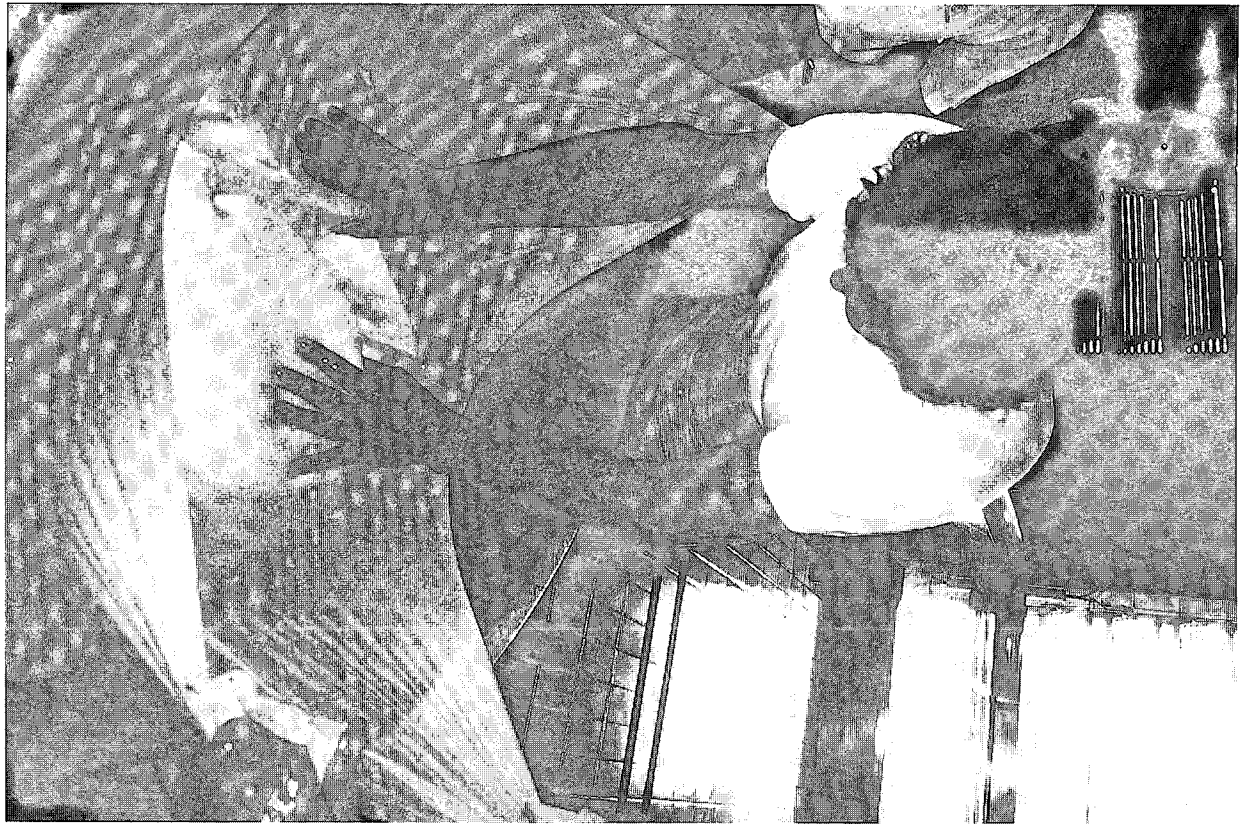
Notes

[1] According to recent surveys carried out with reference to consumer preferences, it is precisely the whiteness of Parmigiano-Reggiano cheese which seems to have become one of the most important measures of its quality for the consumer. In reality, the whiteness of the cheese is a result of the progressive elimination of green fodder from the feed administered to the cows. In contrast, in past centuries cheese makers added small doses of saffron in the milk with the rennet to heighten the natural straw - like colouring of the cheese - a characteristic which was recognized and valued as being distinctively that of Parmigiano-Reggiano. Nowadays the average consumer associates the yellow colouring of the cheese with the presence of excess fats, and so sees it as undesirable, to be avoided with care by the cheese-maker.

[2] This is precisely the characteristic which gave the name 'Grana' to cheese like Parmigiano-Reggiano and Grana Padano.

[3] The principle to respect local, fair and constant customs in the production area has been issued for the first time in article 3 of the Convention of Stresa of 1951, which introduces the designation of origin for cheeses and the protection of the geographical names related to these cheeses.

[4] Natural acidity of milk is expressed in degrees of Soxhlet-Henkel.



4 The Relationship between Product and Region

4.1 Introduction

One of the postulates of this thesis on the Parmigiano-Reggiano system is that the main thrust behind its development is its reliance on 'locally available resources': it is an emblematic case of endogenous development. Locally available resources cover a wide range of specific possibilities including local ecology, local knowledge, locally available labour, craft and skills, local patterns of co-operation and specific institutional arrangements that strengthen local development possibilities. It also covers agro-ecological practices and local organisational patterns. They become valid points of departure for promising development processes only when they are integrated into a self-strengthening, consolidating process (Van der Ploeg *et al.* 1995).

The local ecology of the production area is one of the resources that creates opportunities and constraints for farmers and determines to some extent the 'production possibility curve'. The description given in this chapter will show the huge diversity in soil types, climates and production potential within the production area, but it also focuses on key elements that distinguish the Parmigiano-Reggiano production area from other neighbouring agricultural regions. Local agro-ecological farming practices are the result of the interaction of local farmers' skills with the opportunities and constraints offered by the local ecology. Hence, different farming practices persist within the area. These give rise to different farming styles and these will be analysed in detail in Chapter 9 of this thesis. However, it is important to stress at this point that although one can speak of the co-existence of different styles of farming within the Parmigiano-Reggiano production area, these differences have never provoked disruption within the production system. All dairy farmers comply with the basic production regulations that create the boundaries and the manoeuvring space for different dairy farm development paths.

4.2 General overview of the production area

In 1955, Decree No. 1269 came into force. This defined the Parmigiano-Reggiano production area as being the Provinces of Parma, Reggio Emilia and Modena and that part of the Province of Bologna lying to the west of the River Reno and of the Province of Mantua to the south of the River Po. Together this forms a production area of 1.02 million hectares and with some 550,000 hectare under agricultural production.

Three main sub-areas can be distinguished according to their altitude. The mountain, hill and plain regions differ from each other in rainfall and in climatic and farming conditions. In the Apennine Mountains, for example, farmers work at between 800 and 1200 metres above sea level. The mountain ridge reaches its highest point in Monte Cimone (2163 metres) in the Province of Modena, while in Reggio Emilia the highest peak is Monte Cusna (2121 metres). Long river valleys are common features throughout this mountainous area. These valleys run parallel to each other and are perpendicular to the watershed dividing Emilia Romagna from Tuscany. Most slopes in the mountains are steeper than 20 percent and in the Province of Modena and Reggio Emilia there are also some high plateaux.

Mountain land is generally reasonably fertile and stable, but the combination of steep slopes and average annual temperatures that are lower than elsewhere limit the amount of land that can be used for forage crops, permanent meadows and pasture land. The landscape of the hills is generally dominated by rolling uplands and the average height of the region is 400 metres above sea level. At several points erosion furrows are evident where the clay soil has been exposed to the strong erosive pressures of wind and water. The land is unstable in these areas and landslides are likely. The erosion furrows alternate with other areas where slopes are less steep and the deleterious effect of the clay is mitigated by the presence of sandy deposits giving the land, as a whole, a greater stability. This hydro-geological instability is less common in the vicinity of the mountainous highlands.

The area as a whole slopes gently towards the River Po and the water from the plain flow into it. The higher parts of the plain have been formed over the centuries by deposits from the Apennine rivers. At the river mouth cone-shaped formations have grown up that slope gently towards the mid-plain region. The soil is fine-textured and well-drained. The area is also irrigated by a network of small canals that connect with the rivers. It is possible to identify fluvial deposits that have originated in the countryside between the high plain and the River Po and that been

formed by the deposition of river-borne sedimentation over the centuries. Along these deposits the soil is extremely deep and well drained.

The low-lying areas next to the deposits and those that over the centuries have created the wide riverbed of the Po have been drained during land reclamation schemes. These marshy areas are flooded periodically by both the Po itself and other rivers flowing from the Apennines. The soils of these zones have high clay contents and pose serious drainage problems. They lie a few metres below sea level and water drainage pumps are necessary to keep the water out. Deep ploughing, sometimes to a depth of one meter is essential to ensure reasonable cultivation levels.

4.3 Production potential of the soil

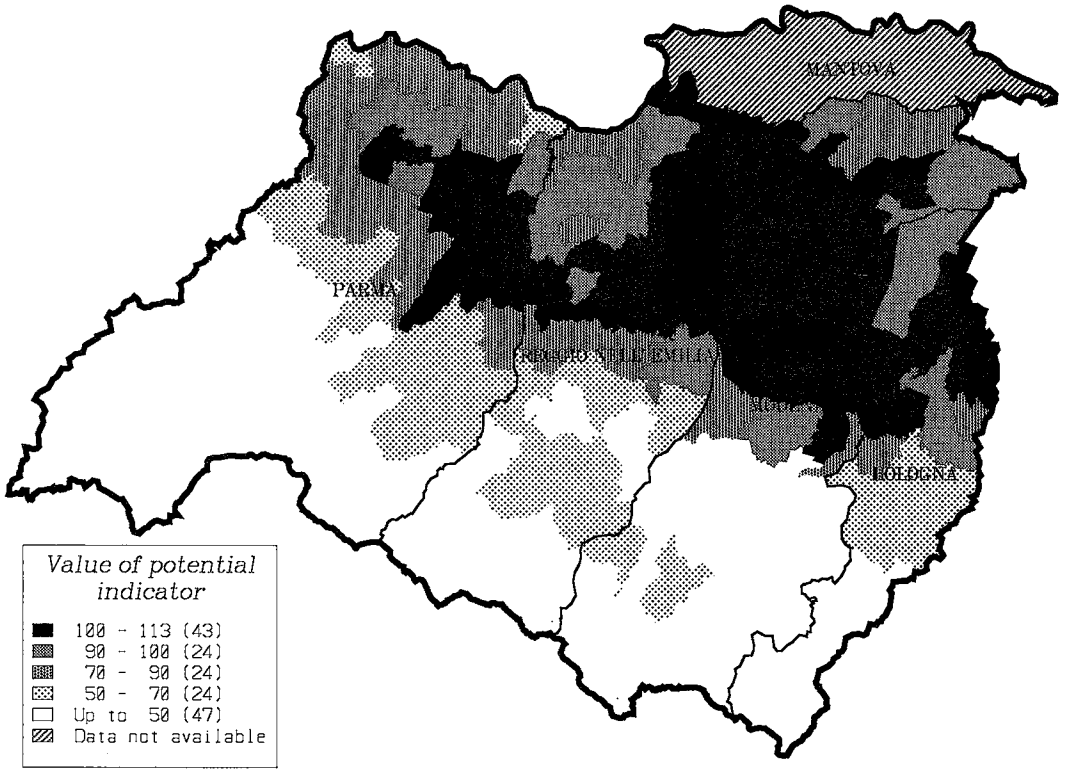
During the 1970s, the Emilia Romagna Region Mapping Service prepared a series of maps with the intention of identifying the productive potential of the soils in the region. The methods used to calculate the index used were based on fundamental physical environment parameters:

1 Height above sea level;
2 Clyvometry: soils classified according to a measure derived from slope steepness;
3 Geopedology: derived from the combination of lithography (the rocks) and terrain type;
4 Propensity to hydrogeological subsidence: areas liable to landslides and characterised by erosive phenomena were shown;
5 The river channel system.

The combination of the physical data derived from these five characteristics make it possible to identify the soil potential and its limits as far as farming production is concerned. Local authority areas have been divided into six classes ranging from high to low productive capacity. Using these six classes it is possible to calculate the productive potential of the soil which runs from a minimum of 100 to a maximum of 600. Converting this again into an average of 100 representing the average for the regional plain, it is possible to create the values set out in Table 4.1.

The plain lands within the Parmigiano-Reggiano district, with the exception of the Parma plain, have a productive potential that is slightly higher than the regional average. The lower productive capacity of the Parma plain and the Ferrara and Piacenza plains can be attributed to the high proportion of drained and reclaimed land adjacent to the River Po. These areas are low in productivity due to water drainage problems.

PRODUTION POTENTIAL OF THE SOIL (Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

Table 4.1 Productive capacity of the soil (average plain Emilia-Romagna = 100)

Province:	Mountain	Hills	Plain
Piacenza	44	72	85
Parma	46	68	89
Reggio Emilia	48	69	103
Modena	46	75	111
Bologna-left Reno	45	77	105
Bologna-right Reno	52	74	106
Ferrara			89
Ravenna		67	108
Forlì	48	75	106
EMILIA-ROMAGNA	47	73	100

Source: Elaborated on data Regione Emilia Romagna Region (RER 1975)

The hilly areas of Parma and Reggio Emilia provinces show lower productive potential indices than the regional average because of the presence of erosion furrows vulnerable to erosive forces. Other hilly areas in the Parmigiano-Reggiano district, however, show higher productive potential than the regional average for such areas.
There is no great variation in the productive potential of the various mountain areas. The only area with above average potential is the Bologna mountains to the west of the River Reno.

These data demonstrate that most of the land in the Parmigiano-Reggiano district is characterised by normal productive potential as far as regional averages are concerned. The only above average exceptions are the Modena plains, with an extremely high productive capacity and the hills of Parma and Reggio that are below average. The physical-environmental characteristics of these latter areas set limits on their agricultural potential.

One of the factors to be taken into account in determining the productive potential of the land is the presence of irrigation. Those areas with irrigation facilities have a significantly higher productive potential and farmers can chose from a wider variety of crops. In the table below, data have been included relating to irrigated land in provinces using the province of Lombardy as a reference. This comparison shows that a lower proportion of exploited agricultural land in the Parmigiano-Reggiano district has access to irrigation plants. The whole area to the south of the Po has less water available for crop irrigation. A large part of the difference between the areas on either side of the Po can be attributed to historical causes.

Table 4.2 Percentage of land under irrigation

Province	Mountain/Hills	Plain
Milan	1.1	77.1
Bergamo	2.0	74.3
Brescia	14.1	89.7
Cremona		86.9
Mantua left of Po	8.7	78.2
Piacenza	14.2	53.2
Mantua right of Po		48.2
Parma	6.8	23.8
Reggio Emilia	5.7	51.3
Modena	5.8	30.4
Bologna left of Reno	3.1	15.4
Bologna right of Reno	5.4	22.6
Ferrara		30.3
Ravenna	9.1	24.0
Forlì	1.7	13.8

Source: Elaborated by CRPA on data of the 4th Agricultural census of 1990 (ISTAT)

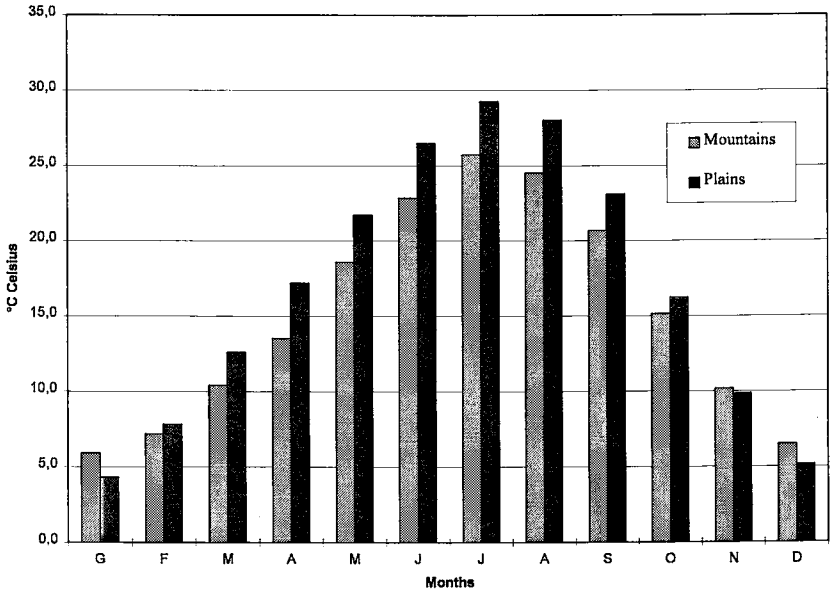
The irrigated meadows system has been used on the Lombard plain for centuries. Here permanently irrigated land allowed fresh forage to be produced throughout the year (the so-called 'marcite'). The permanent meadows were irrigated by running water in summer and winter making it possible to harvest forage continuously even in winter. Most of these meadows have now disappeared and have been replaced by crops with greater forage yield such as maize. The technical structures remain, however, explaining why today almost 80 percent of the agricultural land to the north of the Po is under irrigation. In the Parmigiano-Reggiano production district, on the other hand, the percentage under irrigation is significantly lower, demonstrating that the area enjoys a less favourable position than Lombardy.

4.4 Climatic conditions

The Parmigiano-Reggiano production area has the characteristics of a continental climate with rather hot and humid summers and relatively cold winters. The Apennine mountain chain separates the Po valley from the central Italian regions, where clear Mediterranean conditions prevail. There are significant differences between plain and mountain in the production area. In the mountain area the average maximum summer temperature does not exceed 26° C, the plains experience an average maximum of nearly 30° C. Because of the high relative humidity the difference between maximum and minimum temperature is limited.

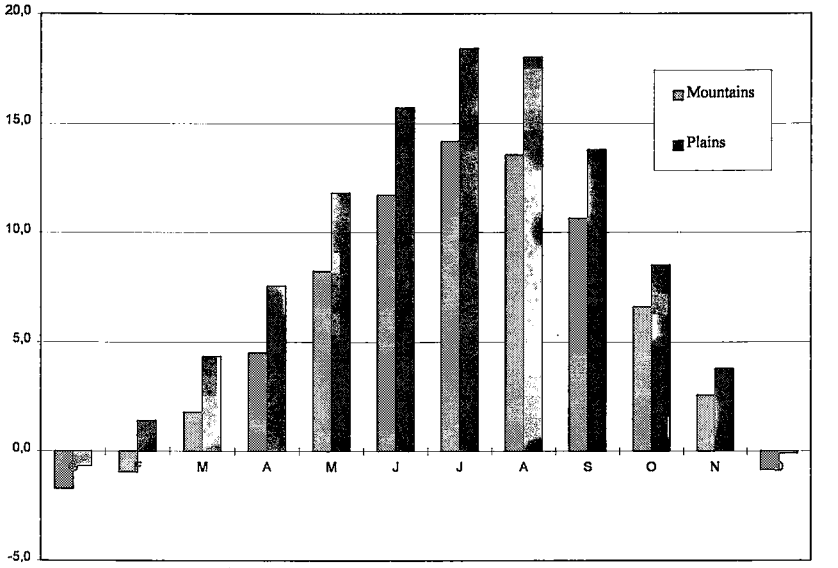
In wintertime frost is quite frequent, especially in the mountains, where snow falls each year. It is striking that the maximum temperatures in December and January, however, are higher in the mountains than on the plains. This is because of the persistent fog that occurs on the plains during periods of high pressure and because there is a lack of wind. Fog can reduce temperatures substantially both during the day and in the night. The highest rainfalls are recorded in autumn, but April and May also have quite high average rainfalls which can have a negative effect on the hay harvest. Hay quality is extremely dependent on the weather during these months and unfortunately they are not the driest months of the year.

Figure 4.1 Average maximum temperature in the Parmigiano-Reggiano production area (1961-1993)



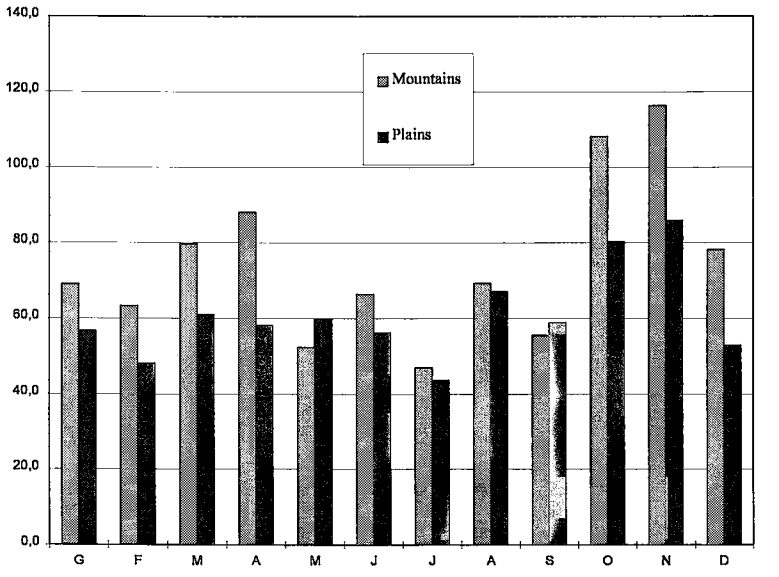
Source: Elaborated on data of Servizio Metereologico Regione Emilia-Romagna

Figure 4.2 Average minimum temperature in the Parmigiano-Reggiano production area (1961–1993)



Source: Developed from data provided by Servizio Metereologico Regione Emilia-Romagna

Figure 4.3 Average precipitation in the Parmigiano-Reggiano production area (1961-1993)



Source: Developed from data provided by the Servizio Metereologico Regione Emilia-Romagna

4.5 Agro-ecological practices and land use patterns

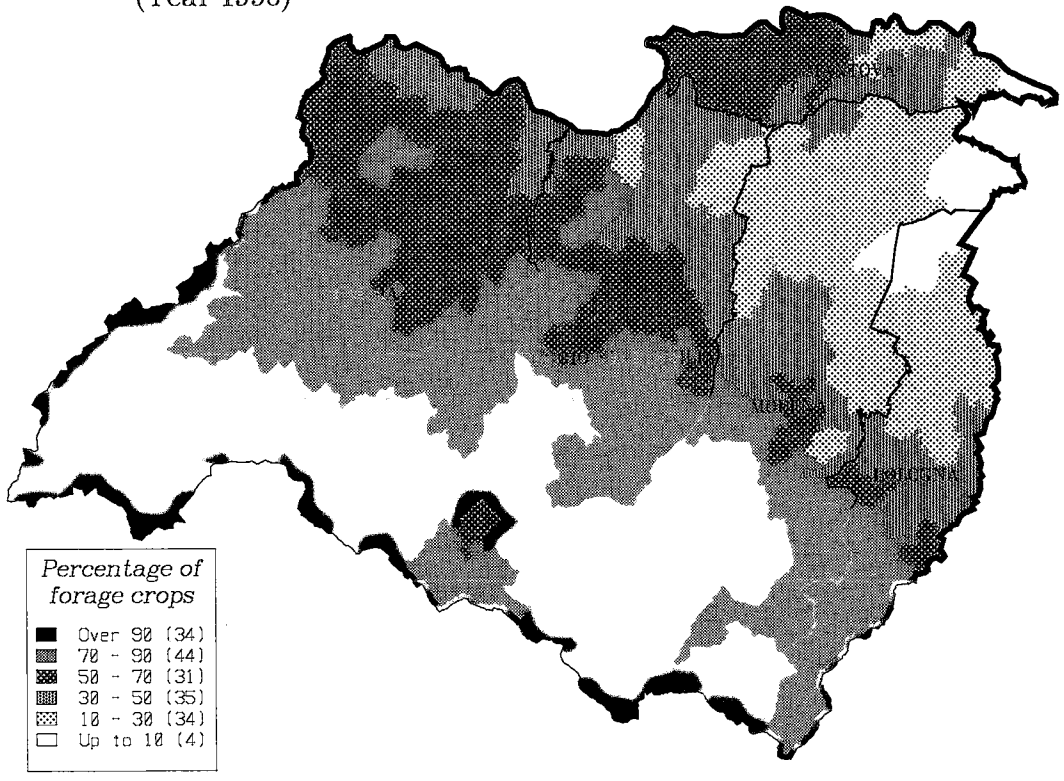
The area has a highly diversified ecology. The climate and pedological differences between mountains and plains generate a variety of agro-ecological practices. However, two common elements can be identified that distinguish the Parmigiano-Reggiano area from neighbouring areas: the predominance of often heavy, clay soils and the relative lack of water for irrigation purposes, particularly in the hot, dry, summer months. How local farmers have developed skills to deal with the opportunities and constraints of their local ecology is discussed below. The district is able to produce a wide variety of crops, the most important of which are forage crops such as drought resistant alfalfa, permanent meadows, grass annuals and pastures. In the mountains and hilly areas, forage crops represent more than 80 percent of the land farmed, whereas on the plain, this percentage varies from 40 percent to 50 percent.

In the mountains the way in which farmed land is divided between the most important crops is quite similar in each province. The area of land under forage crops greatly exceeds that of all other crops and is more than 90 percent in the mountains of Parma, Reggio and Modena and 80 percent in the Bologna Mountains. Bologna is the only area where there is a slight difference. In the mountainous area of Bologna to the west of the Reno, cereal crops, such as wheat and barley have some importance. This contrasts with other mountainous regions where the area devoted to these crops is negligible.

An analysis of crop cultivation in the hills shows that there too the Bologna area differs from the other hillsides in the region. Besides dairy farming, wheat, fruit and vine growing provide an important source of income. Only a half of the farmed land is under forage crops. The Parma hills area has, without doubt, the highest concentration of livestock farming. Three-quarters of the land is devoted to forage crops, while the substantial incidence of wheat is due to the fact that it is used in rotation with alfalfa.

In the Reggio hills livestock farming continues to dominate production. However, there is also a considerable amount of vine cultivated for Lambrusco wine. Cereal crops such as wheat and barley are also found in the typical crop rotation practised by those involved in dairy farming. Fruit growing is important on the hillsides in Modena Province, the principal crop being cherries in the Vignola area, but even so dairy farming still remains the pillar supporting Modena hill farming.

TERRITORIAL DISTRIBUTION OF TOTAL FORAGE CROPS
(Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

In the mountainous and hilly areas forage is often the only crop that can be cultivated. In the plains where the soil has more potential a wider spectrum of farming production is possible. The main producers of forage crops within the Parmigiano-Reggiano plains come from Mantua to the south of the Po, Parma and Reggio Emilia. Farming on the plains in the provinces of Modena and Bologna is strongly influenced by the cereal and fruit cultivation that takes place in neighbouring regions. In these two provinces dairy production is becoming less important relative to other types of agricultural production. The gross value of milk and meat is 22 percent and 13 percent respectively of the total gross value of agricultural production in the area. The reason for a lower level of concentration on livestock production on the plains of Modea and Bologna is partly because the higher productive potential of the soil makes it possible to produce a wider range of crops. Cereals, fruit growing and industrial crops like sugar beet, soya and sunflowers are extremely important in these areas.

The plains with the highest concentration of livestock are those in Parma Province. Here forage crops and wheat account for 65 percent of farmed land. The remaining land is used for growing sugar beet and vegetable crops. There is also a clear concentration on livestock in Mantua and forage crops predominate in the Mantuan cropping programmes. The flat lands of Reggio Province also display a strong bias towards livestock production, although a significant amount of vine is also grown. The Reggio vine-growing region merges with that in the Province of Modena and represents the main area of production for the grapes used in Lambrusco wine.

Pig keeping has not yet been mentioned in this short summary of agriculture in the Parmigiano-Reggiano region. In terms of total gross agricultural production value, its importance varies from 11 percent in the mountainous area of Parma, to 23 percent in the flat lands of Reggio. Pig keeping is rooted historically in its symbiotic relationship with dairy production: pigs are partly fed on whey. Pig keeping still plays a role in Parmigiano-Reggiano and the greater part of production today is concentrated in privately run units that generally make use of local whey.

4.5.1 Forage crops

As has been mentioned earlier, forage crops take up most of the land on dairy farms in the Parmigiano-Reggiano area. However, since the regulations governing Parmigiano-Reggiano milk production impose limits (and sometimes bans) on the type of forage crops and animal feed that can be used in dairying not every species of forage crop can be used.

The most commonly used forage crops are:
1 Alfalfa;
2 permanent meadows;
3 grass annuals such as maize and sorghum;
4 pasture land.

4.5.1.1 Alfalfa
Two-thirds of the total land under forage crops in the Parmigiano-Reggiano district is devoted to alfalfa and this covers some 219,000 hectares. On the plain, the percentage of alfalfa in fodder crops can be as high as 80 percent. However, in the hills it may account for more than 90 percent of the land under forage crops. The cultivation of alfalfa can be considered to be the mainstay of forage production in the Parmigiano-Reggiano district.

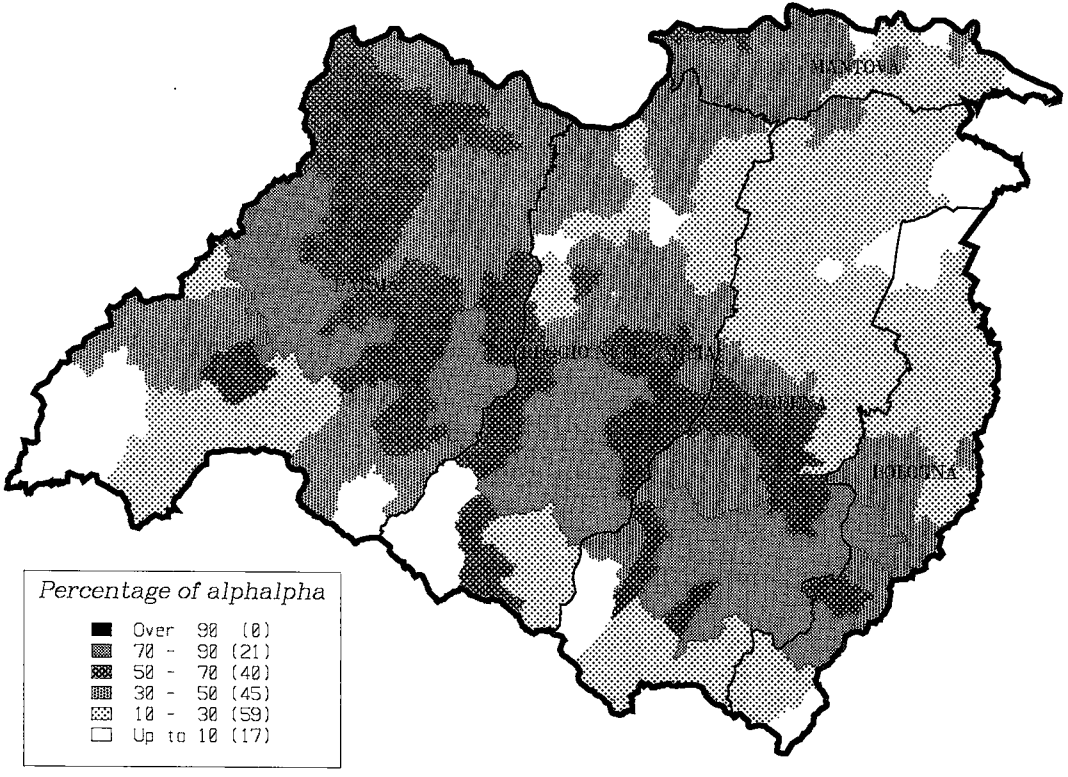
Table 4.3 Percentage cropped to alfalfa out of total land under forage crops

	Plains	Hills	Mountains
MN right of the Po	77.7		
Parma	86.5	90.4	32.4
Reggio	59.7	78.2	58.7
Modena	80.9	66.9	59.2
BO left of the Reno	82.0	79.2	59.4
TOTAL PR area	75.7	81.6	48.6

Source: Developed from data from the 4th Agricultural Census (ISTAT 1991)

Alfalfa is a crop that, while adapting well to a wide variety of rainfall and climatic conditions, increases productivity in deep soils of medium or clay-like consistency. These are found on both the plains and in the hills of the region. A very important characteristic of alfalfa is that it is extremely resistant to dry, hot summer conditions where there is no irrigation. Alfalfa, because of its deep root system, is able to draw on water that lies well beneath the surface. This means that the plant is able to produce acceptable quantities of forage during the summer. Considering the climatic conditions of the Parmigiano-Reggiano zone, and the fact that a significant amount of land in the district is not under irrigation, alfalfa is a particularly suitable crop for Parmigiano-Reggiano dairy farms. A second advantage of alfalfa is that it is able to fix atmospheric nitrogen thanks to the action of symbiotic rhizomes[1]. A field of alfalfa is thus entirely self-sufficient in nitrogen. The crop requires small dressings of nitrogen of 20–30 kilo per hectare to support the plant in the early stages of its development, when the symbiosis has not yet been established. Further the only other feeding it needs is a dressing of phosphate and potassium.

TERRITORIAL DISTRIBUTION OF ALPHALPHA (Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

The environmental consequences of the presence of alfalfa will be analysed in Chapter 11.

The most common rotation pattern is to plant alfalfa for three to four years followed by soft wheat or barley, for example. Subsequently a hoed crop such as maize or tomatoes, or alternatively, another cereal will be planted. Another possibility in intensified forage crop production is to grow a field of pure graminaceae after an alfalfa harvest.

It is important to seek the best balance between quantity and quality of forage production when cultivating alfalfa. The number of times the crop is cut depends on the rainfall in the area. In the plains it varies from five cuttings in dry conditions to six to seven cuttings in areas where the crop is under irrigation. The number of cuttings on hillside fields rarely exceed three or four, while in upland areas the crop cannot be cut more than once or twice. To obtain optimum forage quality, alfalfa is usually cut at the beginning of the flowering phase when the ratio between dry matter, protein content and crude fibres is optimum. After this stage has passed the plant's fibre content becomes too high. The alfalfa is ready for cutting again four to five weeks later.

In the first year the crop is normally in a pure state, but as the years pass it tends to become infested by the spontaneous growth of a collection of different graminaceae. In the third or fourth year these graminaceae begin to take over.
If alfalfa is not irrigated, the first cutting often represents 50–60 percent of the entire annual yield. Successive cuttings each bring in ten percent of the annual yield. In difficult climatic conditions, and when the crop is cut for the last time, yields are minimal. Success in the first cutting is important in order to ensure adequate forage production.

Table 4.4 Alfalfa Yield Data

	First year		Second year		Third year	
	Ton dry matter/ha	Feed Units./ha	ton dry matter/ha	Feed Units./ha	ton dry matter/ha	Feed Units./ha
Plains:						
Irrigated	10	7500	17	12750	12	9000
Not irrigated	8	6000	13	9750	10	7500
Hills	4	4000	9	6750	5	3750

Source: CRPA 1992

Alfalfa yield per hectare varies both with the age of the crop and, of course, with the height above sea level. Alfalfa achieves its highest

production levels in the second year of cultivation. By the third year the field has become infested with *graminaceae* and yields are reduced proportionally.

4.5.1.2 Permanent Meadows

A second forage crop of importance in the Parmigiano-Reggiano district is the permanent meadow. It is the most ancient resource used in the feeding of local cattle. The permanent meadow has its origins in the high plains, the area of oldest human settlement. Historically, these areas were better provided with irrigation water that was taken from the rivers that flowed from the Apennines into the plains. Other areas with a high percentage of permanent meadows are those fed by spring water and spontaneous artesian wells, the result of the pressure the mountains exert on the plain.

Table 4.5 The proportion of permanent meadows in relation to total land area

	Plains	Hills	Mountains
MN right of the Po	0.3		
Parma	7.7	6.5	47.0
Reggio	33.4	15.4	25.8
Modena	2.0	25.6	23.5
BO left of the Reno	3.1	12.4	16.1
TOTAL PR area	13.0	13.1	32.7

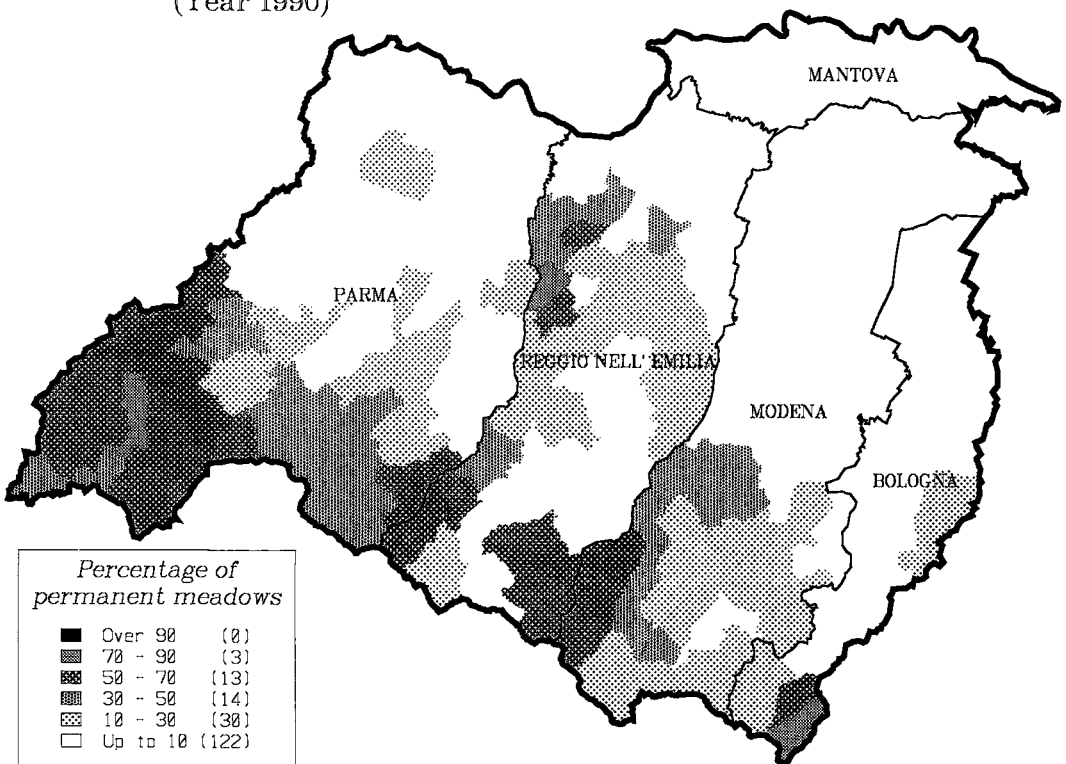
Source: Developed from data from the 4th Agricultural Census (ISTAT 1991)

These meadows are called permanent because, traditionally, they were never 'broken'. They are made up of a multitude of graminaceae and are the result of decades of cultivation. Dressings of organic manure and continuous levelling produces maximum forage yields because this makes the best possible use of the water resources present in the locality. A practice still followed each Autumn is to spread earth and compost made up of layers of matured cow dung separated by layers of earth (Iotti 1991). This compost is produced in rectangular blocks and placed on the meadows near tracks.

The cultivation techniques used for permanent meadows in mountainous and hilly areas differ from the methods used on the plain. The function of the meadow in the hills is to stabilise the soil in sloping areas. Indeed, breaking up the land on the slopes may lead to soil being washed away and the re-introduction of erosive processes. Permanent meadows not only ensure a supply of forage but also impede subsidence.

In the Parmigiano-Reggiano district some 64,271 hectares or 20 percent of the total land area under forage crops is covered by permanent meadows.

TERRITORIAL DISTRIBUTION OF PERMANENT MEADOWS
(Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

The permanent meadows on the plain are, for the most part, concentrated on the high plain in Reggio province, in the local municipalities of Bibbiano, Cavriago, S. Polo, Montecchio and S. Ilario. Land where spring water is available is found in the local municipalities of Gattatico and Campegine in the province of Reggio and in some parts of Parma like Fontevivo and Fontanellato[2]. Most of the permanent meadows (36,917 hectares) are to be found in the mountainous areas of the Parmigiano-Reggiano district where they represent one of the more important forage crop resources (33 percent).

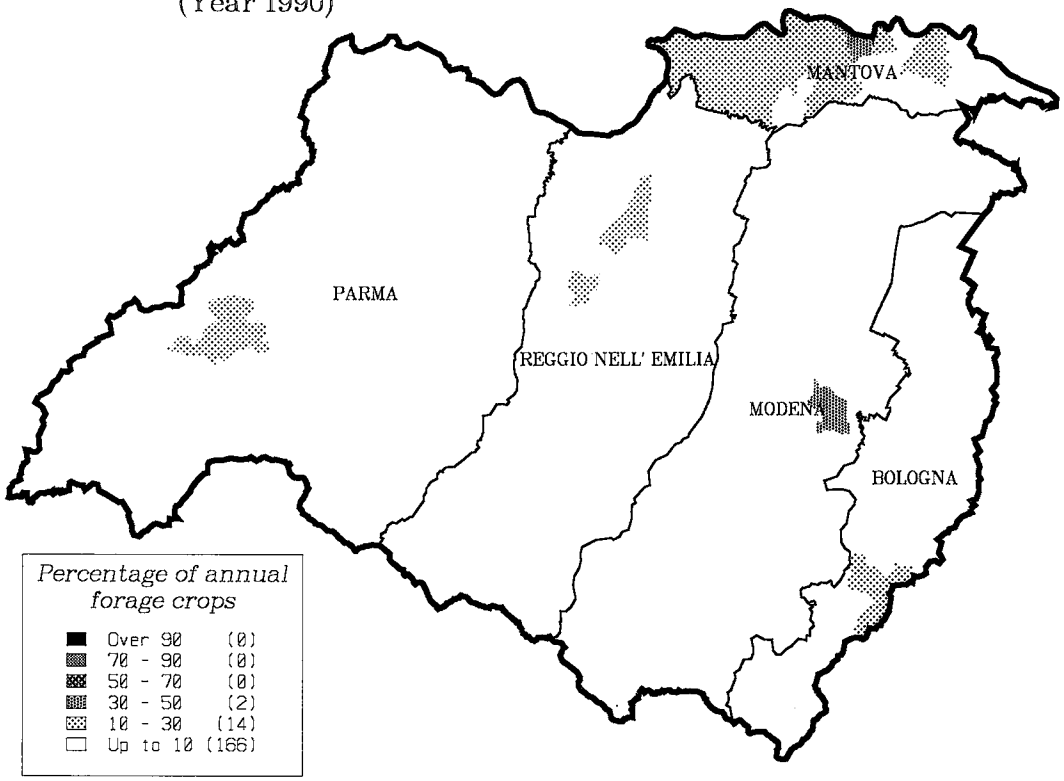
In contrast to alfalfa, the permanent meadow requires a considerable dressing of nitrogen fertiliser. The best time to carry out the first cutting for a meadow of graminaceae is between germination and before the plant is fully grown. This procedure produces the best compromise between forage quality and quantity. By following this technique and applying 150 kilo of nitrogen fertiliser and 40 kilo of phosphate, yields that vary between 10 and 12 tons of dry matter per hectare can be achieved. Consequently, meadow yields are slightly less than those obtained from alfalfa, particularly if they are compared to the second year of an alfalfa crop. In compensation, the energy levels obtained from a permanent meadow are higher.
Hay from the permanent meadow is given to dairy cows to avoid the risk that too much protein is included in their feed. About 12 percent of the dry matter in the hay from graminaceae is crude protein as opposed to 17–18 percent in alfalfa hay.

4.5.1.3 Grass Crops
Annual grass crops have only been cultivated in relatively recent times on Parmigiano-Reggiano dairy farms. The most common annual forage grasses are maize and sorghum. Festucca and mazzolina grasses are less common. These crops were introduced into the cropping programme to supplement forage resources during September and October, a critical period as far as forage yield from alfalfa and the permanent meadows is concerned. Maize and sorghum are harvested in September when plants are still green and they provide an important supplement to the animals diet. Before being given to the livestock, the maize is chopped up so its nutritious properties are made readily accessible. The production regulations prescribe that green maize should be administered to the cows immediately in order to avoid fermentation.

Grasses are grown almost exclusively on the plain. In 1990, the area under these crops accounted for nearly 13,000 hectares of the Parmigiano-Reggiano district.

TERRITORIAL DISTRIBUTION OF ANNUAL FORAGE CROPS

(Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

Dairy farms in Mantua Province make the most use of these grasses. Indeed, in this area they represent 22 percent of total forage crops. Grasses represent 15 percent of all forage sources in the plain of Modena as well.

Table 4.6 Proportion of annual grass forages within the total land area (%)

	Plains	Hills	Mountains
MN right of the Po	22.0		
Parma	5.8	0.0	0.0
Reggio	6.7	0.0	0.0
Modena	15.9	0.0	0.0
BO left of the Reno	11.7	0.0	0.1
TOTAL PR area	10.8	0.0	0.0

Source: Developed by CRPA from data from the 4th Agricultural Census (ISTAT 1991)

4.5.1.4 Pasture Land

Cattle are rarely grazed in the Parmigiano-Reggiano area. Historical research has shown that this was also the case in the past (Iotti 1991). There are a few exceptions to this in the mountainous areas.

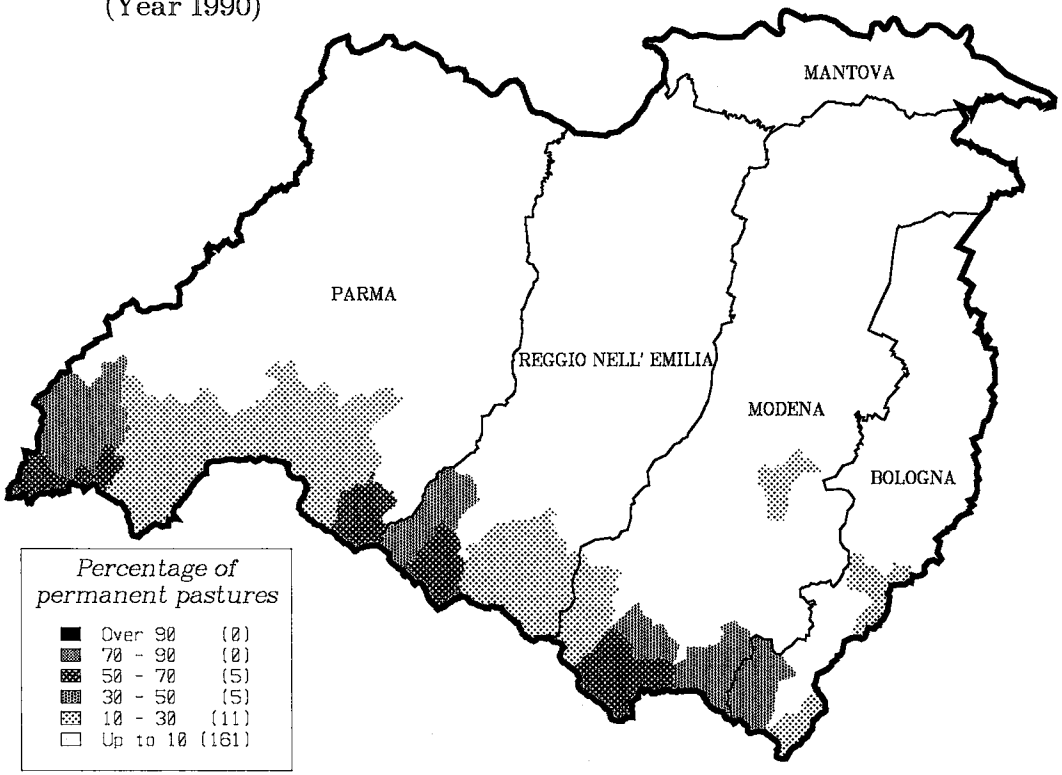
Table 4.7 Proportion of Pasture land out of total land under forage crops (%)

	Plains	Hills	Mountains
MN right of the Po	0.1		
Parma	0.1	1.1	19.1
Reggio	0.3	2.8	14.5
Modena	1.1	3.2	15.2
BO left of the Reno	3.2	4.8	14.7
TOTAL PR area	0.5	2.3	16.5

Source: Elaborated on data 4th Agricultural Census (ISTAT 1991)

Pastureland that is confined almost entirely to the mountainous areas in the Parmigiano-Reggiano district is used for pasturing young breeding cattle. But this too is a practice only followed by a few dairy farmers. A substantial part of the land described as pasture does not, in fact, represent a forage resource for the cattle of the Parmigiano-Reggiano district. The official ISTAT statistics for 1990 indicate there is about 21,322 hectares of pastureland. It is difficult, however, to establish how much of this is actually used because it is difficult to survey a land category that can easily be confused with abandoned farmland. In addition, some of the pasture land is also used for sheep grazing.

TERRITORIAL DISTRIBUTION OF PERMANENT PASTURES
(Year 1990)



Elaborazioni C.R.P.A. – Reggio Emilia

4.5.1.5 Cereal crops
Soft wheat is sown in October and harvested in June. Typical cultivation stages include preparing the land, sowing, manuring and pest control. These activities are carried out by the farm work force directly. Harvesting, however, is generally contracted out. Most of the cereal produced is sold to selling and buying co-operatives or else to private animal feed companies. Compound feeds are bought from these same co-operatives and integrated into dairy cattle rations.

While what has been described above represents the most common practice among small- and medium-sized farms, different commercial and technical practices can also be found. Thus, for example, it is quite common for the farms to sell cereals to small mills specialised in the milling of grain and then supplement these with protein rich foodstuff bought from outside the area such as soya, linseed or sunflower seed flour. The farmer, in fact, buys supplemented grain back from the mill.

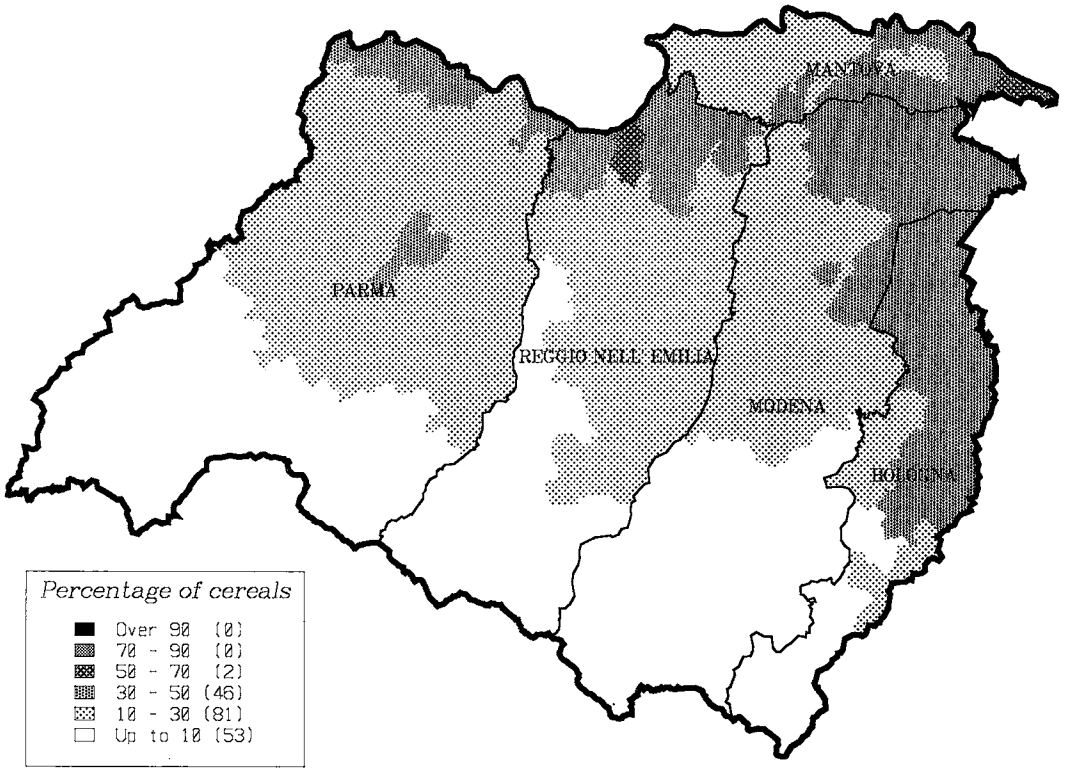
To reduce feeding costs, big farms often have plants especially designed for mixing foodstuffs. Some of these are made up from cereal crops produced by the farm itself others are made up of feeds bought from the outside. In such cases, the entire cereal production of the farm is re-used internally. Another practice is to have barley grain pressed by an animal feed manufacturer. The barley is first sold to, and then re-bought from the manufacturer. Pressing the barley increases the nutritional value of this cereal.

4.6 Territorial distribution of dairy farming

In 1990, the total number of dairy cows in the Parmigiano-Reggiano district was 336,000, some 15 percent of the entire Italian national dairy herd. Most of the cows are to be found on the plains (62 percent) and particularly in the Provinces of Reggio (20 percent) and Parma (17 percent). The region to the south of the Po, in Mantua Province, has 12 percent of the Parmigiano-Reggiano region dairy herd.

The majority of dairy farming in Parmigiano-Reggiano takes place on the plain. Only one third of the cows are kept in the hills or mountains. When we look at the hills in more detail we find that the most cows are found in the Province of Parma. This can be explained by the fact that the Parma hills are more extensive that the hilly land in other provinces and their slopes are less steep. This makes them particularly well adapted to forage crops.

TERRITORIAL DISTRIBUTION OF CEREALS (Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

The mountainous area of the Parma Province, however, is marginal from all points of view. As the mountains are concerned the greatest concentration of dairy cows can be found in the mountains of Modena and Reggio.

In Modena 50 percent of the provinces dairy herd is kept in the hills and mountains. The mountainous area with the highest cattle population density is in the immediate vicinity of Pavullo, a small town at 700 metres above sea level. Here pedological conditions are typical for a high plateau. In the mountains of Reggio, the most important dairy farming areas are the municipalities of Castelnuovo Monti and Carpineti. Together they form a similar type of high plateau at an altitude of 700 metres. In these sub-areas the pedological and climatic conditions are particularly favourable to dairy farming and farms tend to be larger in size.

The Province of Bologna to the west of the Reno is very marginal so far as dairy farming is concerned. There are only about 11,000 dairy cows in the area and these are mostly found in the hills and mountains. There is very little dairy farming on the Bologna plain.

Table 4.8 Number of Dairy Cows in the PR area

	Plains	Hills	Mountains	TOTAL
	Cows	Cows	Cows	Cows
MN right of the Po	40,136			40,136
Parma	58,689	37,604	10,816	107,109
Reggio	69,702	20,883	15,400	105,929
Modena	36,558	14,709	20,573	71,840
BO left of the Reno	3,903	4,261	2,933	11,097
TOTAL PR area	208,988	77,457	49,722	336,111
	%	%	%	%
MN right of the Po	11.9			11.9
Parma	17.5	11.2	3.2	31.9
Reggio	20.7	6.2	4.6	31.5
Modena	10.9	4.4	6.1	21.4
BO left of the Reno	1.2	1.3	0.9	3.3
TOTAL PR area	62.2	23.0	14.8	100.0

Source: Developed from data from the 4th Agricultural Census (ISTAT 1991)

The map shows the three sub-areas with the greatest concentrations of dairy cows per hectare:

1 *The western Parma plain* consisting of the municipalities of Busseto, Soragna and Fontanellato.

2 *The high Reggio plain* consisting of the municipality of Reggio Emilia and land in the immediate vicinity where the old permanent meadows are concentrated. The area includes the municipalities of Bibbiano, Montecchio, Cavriago, Gattatico, Campegine and Castelnuovo Sotto and its high-density dairy farming extends into Parma with the local authority area of Montechiarugolo. It is within this collection of municipalities that Parmigiano-Reggiano has its historical roots. Recent statistics confirm that this is still the area with the highest concentration of dairy cows: there are more than two dairy cows per hectare of forage crops.
3 *The western part of the Mantuan plain to the south of the Po.* This area, connected to the Reggio municipality of Luzzara, has a strong dairy farming presence. It has already been noted above that the main forage crops for this area are alfalfa and annual grasses such as maize. It is precisely the high yield per hectare achieved from maize that makes possible the density of dairy cattle per hectare.
4 *The Modena hills.* This region comprises the local municipalities to the south of the provincial capital including Sassuolo, Formigine and Castelnovo Rangone.

Table 4.9 Stocking rate of dairy cows per hectare forage area

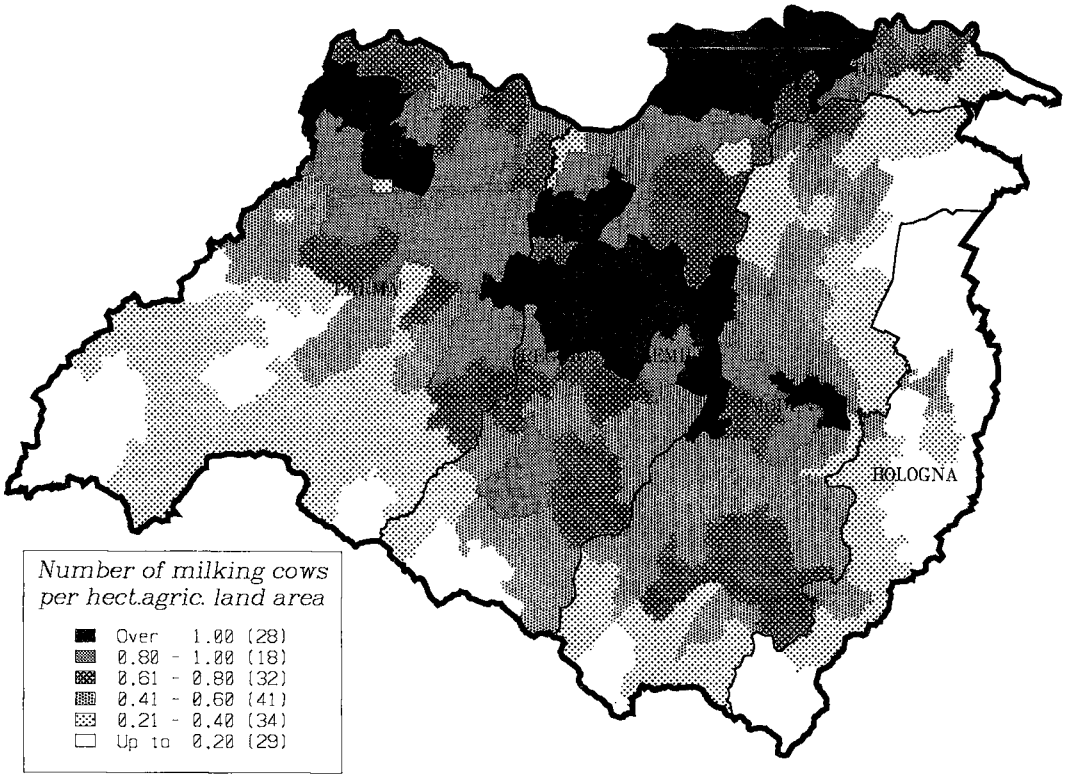
	Plains	Hills	Mountains	TOTAL
MN right of the Po	2.1			2.1
Parma	1.6	0.9	0.2	0.9
Reggio	1.9	1.0	0.6	1.3
Modena	1.5	0.8	0.6	0.9
BO left of the Reno	1.0	0.5	0.4	0.5
TOTAL PR area	1.7	0.9	0.4	1.0

Source: Developed by CRPA on data from the 4th Agricultural Census (ISTAT 1991)

4.7 Product quality and link with local factors

During the long and slow ripening process, Parmigiano-Reggiano cheese, like all cheeses, undergoes a protein degradation (proteolysis) that lead to the formation of peptides, free amino acids and the products of their catabolism. These processes determine to a large extent the structure, aroma and flavour of the cheese (Bertozzi *et al.* 1993). Biochemical research has shown that the specific indigenous bacterial flora of the raw milk has a decisive influence on the proteolysis process and thus on the final organoleptic quality of the cheese (Panari *et al.* 1988; Resmini *et al.* 1988).

STOCKING RATE OF MILKING COWS (Year 1990)



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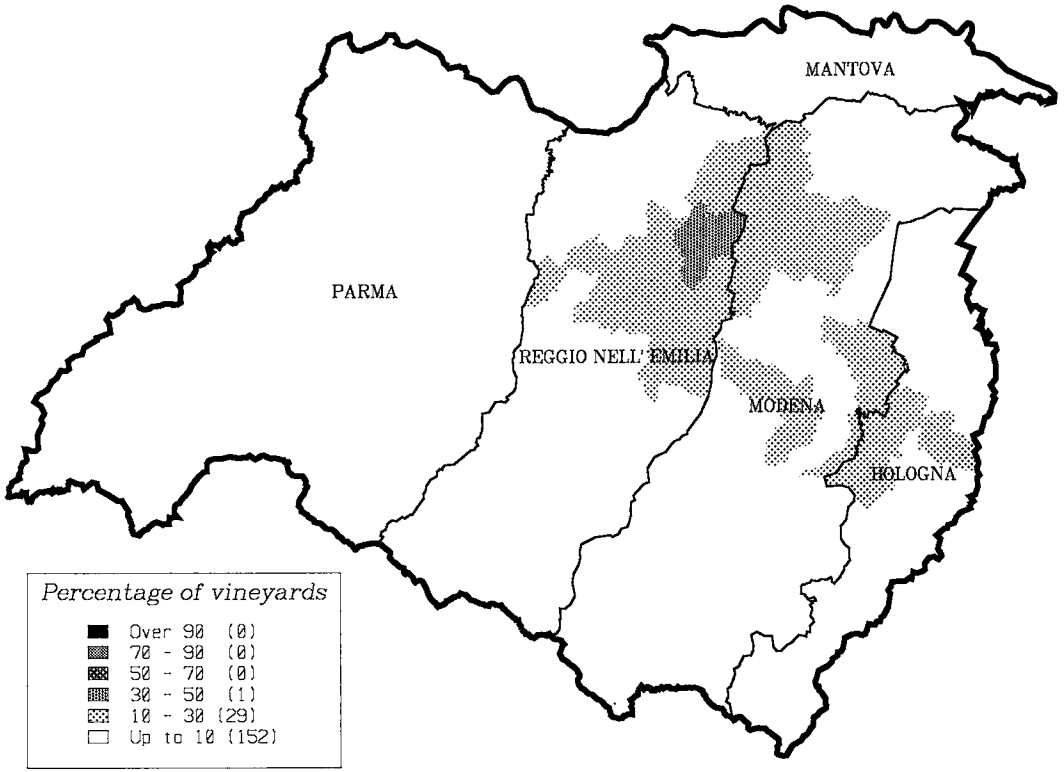
TERRITORIAL DISTRIBUTION OF VINEYARDS (Year 1990)



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Each cheese factory reproduces its own bacterial flora each day when it adds soured whey from the previous day's cheese-making to the milk as a natural starter. The bacterial flora is heavily influenced by the techniques used to feed the cows on individual dairy farms.

Two factors are of great importance to the organoleptic quality of the cheese:

1 The indigenous bacterial milk flora, preserved by means of raw milk processing, which in its diversity of species is responsible for the colour, taste and flavour of the cheese.
2 The artisan ability of the Parmigiano-Reggiano cheese-makers who process the different types of milk, the quality of which changes from farm to farm and from season to season.

The varying geopedological and climatic conditions that prevail in the Parmigiano-Reggiano production area have been described above. The physical conditions of the different sub-areas support a variety of different forage cropping patterns and hence cow rations. Differences in cow rations give rise to variation in the type of milk produced and this in turn affects the qualities of Parmigiano-Reggiano cheese. In this way the natural conditions of the production area directly affect the quality of the cheese which varies from sub-area to sub-area, the highest quality being achieved in the hills and mountains. Generally speaking quality tends to be lower on the lower plains in the vicinity of the Po, where the proportion of annual grasses like green maize in the animals' diet can be quite considerable.

Of course, a skilled artisan cheese-maker may be able to correct some of the variation in milk quality caused by the natural conditions on the farm of origin. As has been illustrated in Chapter 3, the artisan nature of the cheese-makers' work lies in the ability to work with raw milk qualities that vary from farm to farm and from season to season without recourse to chemical additives. Variations may occur in the natural creaming capacity of the evening milk, in the timing of coagulation and in the consistency of the curd which in turn can be attributed to differences in breed and in the feeding techniques used. Each day Parmigiano-Reggiano cheese-makers make decisions about the quantity and timing of rennet and whey starter appropriate for each vat that will eventually become Parmigiano-Reggiano cheese. It is thus the combination of *the natural and human factors* that determine final quality.

The production regulations set restrictions designed to prevent the development of undesirable practices that might compromise the general quality image of the cheese. Variations in quality must not be allowed to

become too great, otherwise the whole Parmigiano-Reggiano system may be damaged because consumers will be left with a perception of poor quality.

Notes

[1] Most of the soils within the PR area contain bacteria of the genus rhizobium, capable of penetrating into the roots of leguminous plants and provoking the formation of root nodules resulting from the increase in bacterial numbers. Since the bacterium-plant interaction is favourable to both, it is called symbiosis. These bacteria have the ability to fix atmospheric nitrogen in a form which can also be used by the plant. The quantity produced in this way, which, in the first year of cultivation can reach 100 kilo of nitrogen per hectare (CRPA 1994, Sewage Manual) is sufficient to satisfy the needs of both the bacteria and the plants. It also permits the growth of other species of associated grasses, graminaceae in particular while also enriching the soil with nitrogen (CRPA 1992A).

[2] The historic names of this local authority evidence the presence of artesian wells.

5 Production Structure

5.1 The productive structure of the farms

Parmigiano-Reggiano cheese is the main stay of the livestock-farming sector within its officially recognised area of production. From the data delivered by the Parmigiano-Reggiano cheese *Consorzio*[1] it can be seen that the average milk production of Parmigiano-Regiano dairy farm was 214 tons of milk in 1999. Two factors are important here. First, a typical farm within the Parmigiano-Reggiano district is small to medium in size. Second, there is a significant difference between the structure of dairy farms on the plains and those in the mountains. In 1999, an average plain farm produced 266 tons of milk. This corresponds to a herd of about 40 dairy cows. A dairy farm in the mountains has a production that is slightly in access of 130 tons of milk a year and an average herd size of 25 milking cows. This means that an average mountain farm has about half the productive potential of an average farm on the plain. Altitude level is thus a fundamental factor in determining the structure of the Parmigiano-Reggiano production system as a whole.

The majority of dairy farms in the district are, by and large, family farms. Only a small number of farms are run on purely business principles or managed in a company form.

There are 7,361 Parmigiano-Reggiano dairy farms in the Parmigiano-Reggiano district, and almost 40 percent of them have no more than 20 head of dairy cattle. Such extremely small herds, however, account for only eight percent of the total number of dairy cattle in the Parmigiano-Reggiano area. At the other extreme, ten percent of the dairy herds in the area have more than 100 heads of cattle and account for almost 40 percent of the cattle in the Parmigiano-Reggiano district.

Table 5.1 Number of Parmigiano-Reggiano dairy farms and production structure according to province and altitude zone 1999

	PR dairy farms			Average milk production		
	Total N.	Plain N.	Mountains N.	Total ton milk	Plain ton milk	Mountains Ton milk
MN right of the Po	641	641		274	274	
Parma	2,557	1,616	941	218	272	125
Reggio	2,319	1,446	873	213	264	127
Modena	1,685	752	933	186	248	136
Bologna left of the Reno	159	57	102	209	323	145
Totale	7,361	4,512	2,849	214	266	130

Source: Consorzio Formaggio Parmigiano-Reggiano

Table 5.2 Productive structure of the dairy farms according to province and herd size – 1998

	% dairy farms				
	1–19 heads	20–49 heads	50–99 heads	> 100 heads	total
Parma	39.1	32.3	18.0	10.6	100.0
Reggio	41.1	37.9	24.0	12.8	100.0
Modena	47.2	27.5	17.9	7.4	100.0
TOTAL PR area	40.0	31.2	18.9	9.9	100.0
	% heads of cattle				
Parma	8.5	23.1	27.6	40.8	100.0
Reggio	7.6	21.9	29.7	40.8	100.0
Modena	10.9	22.8	32.0	34.2	100.0
TOTAL PR area	8.8	22.6	29.4	39.2	100.0

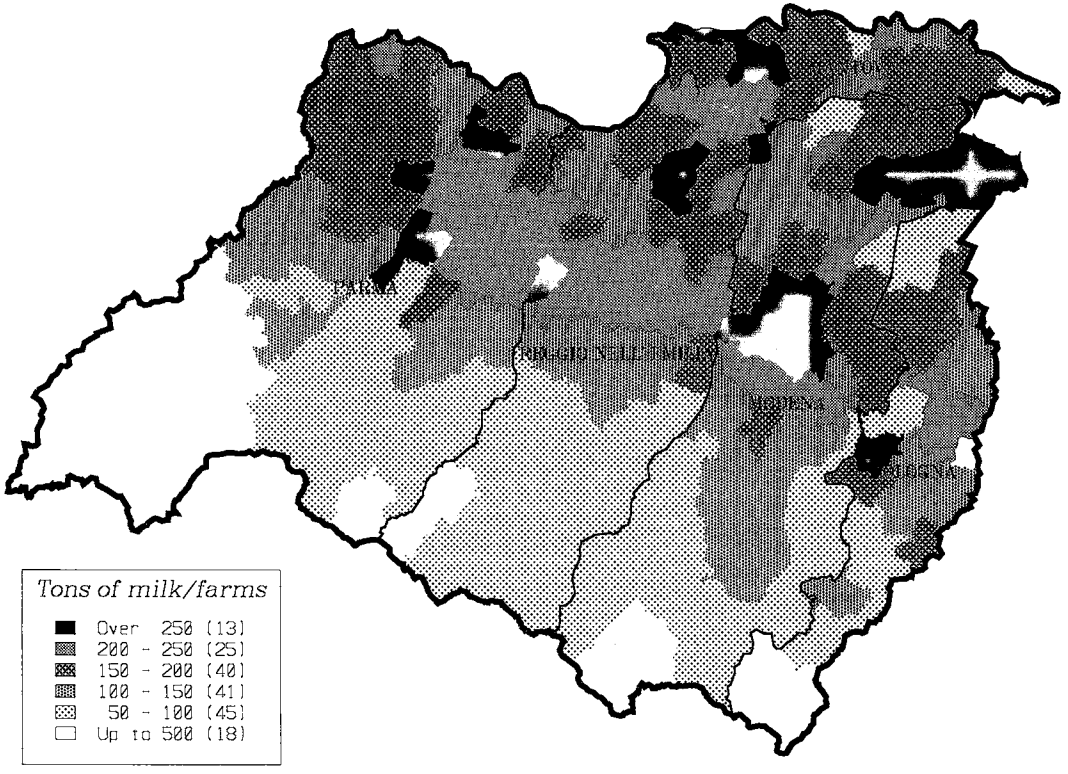
Source: Developed from data from the Veterinary Services and Region Emilia-Romagna

5.1.1 The plain

On the plain the statistics relating to average farm size in the various provinces do not reveal significant differences in farm structure. The number of small herds is above average only on the plains of Bologna. The detailed map showing individual local municipalities reveals several interesting differences in size. There are three areas that contain particularly high concentrations of large farms:

- the municipality of Parma and its immediate surroundings;
- the north-eastern part of the Reggio plain (Rolo, Luzzara, Reggiolo) and the western part of the Mantuan plain to the east of the Po;
- the municipality of Modena and its immediately surroundings.

STRUCTURE OF DAIRY FARMS (Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

In these three sub-areas more than 50 percent of dairy cows are kept on farms with herds of 50 or more cows. From a comparison of the concentration of dairy farming and the productive potential of the farms, it can be seen that the sub-areas identified as having the largest farms do not match those with the highest productive potential, except in the case of the western Mantuan plain where there are large herds and a high density of cattle per hectare. In the province of Parma, most large farms are concentrated in the municipality of Parma and adjacent municipalities. However, the area with the highest cattle population density per hectare is located in the western part of the province. It is thus a question of phenomena that are to some extent independent of each other.

The size of the farms can be explained by the agricultural history of the locality and by the survival of a strong land-owning network, which has been able to maintain its dominance in spite of the economic and social changes that have occurred in the last century.

5.1.2 The mountains

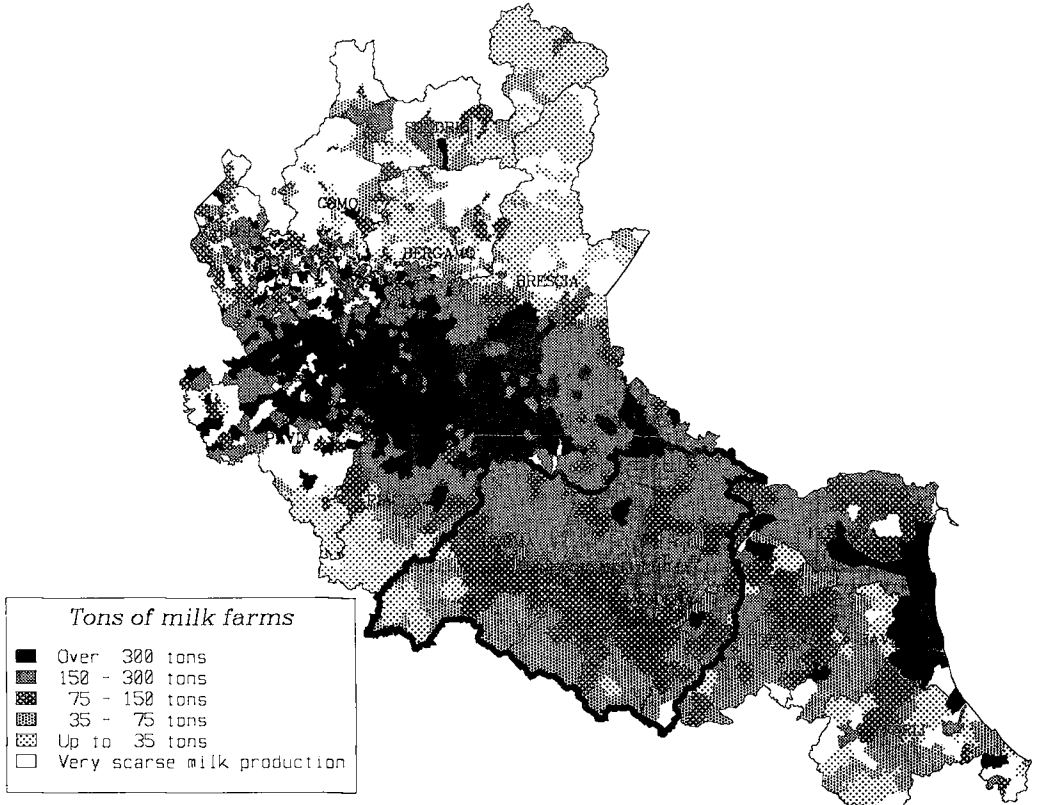
In 1999, there were 2,849 dairy farms in the mountains representing 23 percent of Parmigiano-Reggiano milk production. The structure of production in this region is characterised by farms with an average milk production of 130 tons. The small farms that often produce no more than 50 tons of milk a year, are frequently run by pensioners who supplement their income with the proceeds of Parmigiano-Reggiano milk. There is considerable diversity in the farms in the mountains and in their productive structure. Alongside the many small farms that have little weight in economic terms, there are farms that are able to generate a significant income.

On the accompanying map, it can be seen that Modena has the highest concentration of large dairy farms. In the municipalities of Pavullo and Zocca about 30 percent of the cows are in large herds.

5.1.3 Dairy farm structure in neighbouring areas

As we mentioned earlier, Northern Italy is responsible for more than 80 percent of Italian milk production. It is therefore interesting to compare the structure of dairy farms in the Parmigiano-Reggiano district with neighbouring areas specialising in milk production. The most important milk-producing region in Italy is Lombardy, which accounts for more than 30 percent of total Italian milk production. Most of this milk is destined for industrial processing and does not have to comply with specific production regulations[2].

FARM SIZE OF DAIRY FARMS (Year 1990)



Elaborated by: Centro Ricerche Produzioni Animali – Reggio Emilia

Here maize and grass silage is important for its roughage components and compound feeds may contain a series of industrial by-products. These dairy farms are in direct competition with other European dairy systems as the local dairy industry relies quite heavily on imports of liquid milk from Bavaria and France.

Dairy farm structure in Lombardy is quite different from the structure of dairy farms in the Parmigiano-Reggiano district. In the plains in the provinces of Milan, Cremona, Mantua and Brescia, there is a predominance of large-scale dairy farms and herd sizes of 150 to 300 dairy cattle are quite common. There are two reasons for the size of the dairy farms in this region:

1 Historically, farms on the Lombardy plains were created by a class of aristocratic landowners who relied mainly on salaried labourers. These labourers lived on the farm with their families. The large dairy farms of today still use salaried labourers although now they come increasingly from countries like Morocco, India and Albania.
2 The fierce competition with other dairy farmers in Europe and the lack of any possibility of exploiting the pasture system makes it necessary to increase herd size in order to exploit economies of scale and reduce milk production costs.

The dairy farm structure on the Lombardy plains is therefore completely different to that of the Parmigiano-Reggiano district. To a large extent this is the result of a quite different input-output price ratio. Lower milk prices force local dairy farms to cut costs continuously in order to stay in the market.

5.1.4 Structural changes in the 1980s and 1990s

Dairy farming in the Parmigiano-Reggiano district has undergone large-scale restructuring. In the 1980s one-third of the farms closed, a trend that has continued into the 1990s. In this respect the Parmigiano-Reggiano district is not a 'happy island' immune to significant structural change and it is evident that change can have negative consequences for employment. Nevertheless this process involves aspects that, in contrast to other dairy farm systems, differentiate its development.

First, the decline in the number of dairy farms in the 1980s followed a similar dynamic in the three sub-areas: mountains, hills and plains. Between 1982 and 1990, all three sub-areas lost about 35 percent of their farms. Compared to the dynamics of other mountain areas outside the Parmigiano-Reggiano district or in the Alpine areas of Lombardy, the resistance to change in the Parmigiano-Reggiano mountains is highly significant. The Alpine areas, which do not enjoy specific public

development grants[3] and which have no alternatives to cattle farming all show a drastic decline in dairy farming.

Table 5.3 Percentage variations in the number of dairy farms and dairy cow populations between 1982 and 1990

	Dairy farms			Dairy cows		
	Mountains	Hills	Plains	Mountains	Hills	Plains
Parma	-50.7	-31.6	-29.2	-17.2	16.6	10.6
Reggio	-29.4	-33.7	-35.1	14.1	9.8	1.9
Modena	-36.0	-36.2	-41.4	12.8	6.2	-6.1
Total	-35.4	-33.3	-35.0	4.4	12.4	2.8

Source: Developed from data from the 4th Census of Agriculture (ISTAT 1991)

On the one hand, the number of herds in the Parmigiano-Reggiano district has decreased while on the other, during the same period, the total size of the dairy herd increased by five percent. This increase has been seen in the mountains (plus four percent) and the plains (+2.8 percent).

Table 5.4 Percentage variation in farm numbers per herd-size classes between 1982 and 1990

	1-9 cows	10-19 cows	20-49 cows	> 50 cows	Total
Parma	-63.8	-33.7	+21.2	+81.7	-36.8
Reggio	-59.4	-31.6	+29.7	+45.4	-33.5
Modena	-60.2	-20.5	+37.6	+34.5	-38.1
Total	-59.5	-28.6	+28.9	+55.4	-34.7

Source: Developed from data from the 4th Census of Agriculture (ISTAT 1991)

Of particular interest is the decline in the number of small farms (-59 percent). The data shown in Table 5.4 seem to suggest that only small farms closed down whilst the large ones increased in size. Although this is partly true, it should be stressed that the increase in the number of medium and large farms is the result of continuously increasing herd size on small farms. Farms in the small-herd size class have moved into larger herd-size classes. The significant increase in the number of large farms is therefore the result of small farms becoming bigger and bigger. It is very rare to find new entrants coming into dairy farming from outside the industry.

Within the Parmigiano-Reggiano district different styles of farming co-exist, each following a specific development path. The analysis of these different styles of farming and their behaviour on the market will be elaborated further in Chapter 9 using results derived from of a farm

survey. Here we will confine ourselves to noting the most significant and interesting trends as revealed by official statistics.

The decline in farm numbers, as we have seen, is evident in the first two size categories. The proportional weight of the various size categories in relation to total farm numbers has thus changed considerably. Table 5.5 indicates the change in each size category in terms of its relation to the whole. The difference has been calculated on the basis of the difference between the proportion each size category bore to the whole in 1982 and the same proportion for the same size category in 1990. A positive difference indicates a relative increase in the category's proportional share of the total.

For obvious reasons the proportional share of the smallest farms has dropped sharply. For the other size categories the change has been more gradual. It should be noted in particular that, despite a total reduction in the number of farms by 10 to 19 cows, the proportional share of the total number of farms in this size category has increased in all three provinces. The medium-sized farms with 20 to 49 cows increased their overall share to a greater extent (+13.5 percentage points). The share of the large farms has increased but at a reduced rate when compared with those in the medium size bracket. This further confirms the central role played by medium-sized farms in the Parmigiano-Reggiano district.

Table 5.5 Variations in proportional share of four herd-size categories between 1982 and 1990

	1-9 cows	10-19 cows	20-49 cows	> 50 cows
Farms	Percentage points	percentage points	Percentage points	percentage points
Parma	-23.0	1.3	15.0	6.8
Reggio	-20.6	0.8	13.9	5.8
Modena	-23.0	6.2	12.4	4.4
Total	-21.5	2.4	13.5	5.7
Dairy cows	Percentage points	percentage points	Percentage points	percentage points
Parma	-11.7	-9.5	5.8	15.4
Reggio	-10.7	-7.7	6.9	11.5
Modena	-13.6	-4.6	10.2	8.0
Total	-11.8	-7.6	7.4	12.0

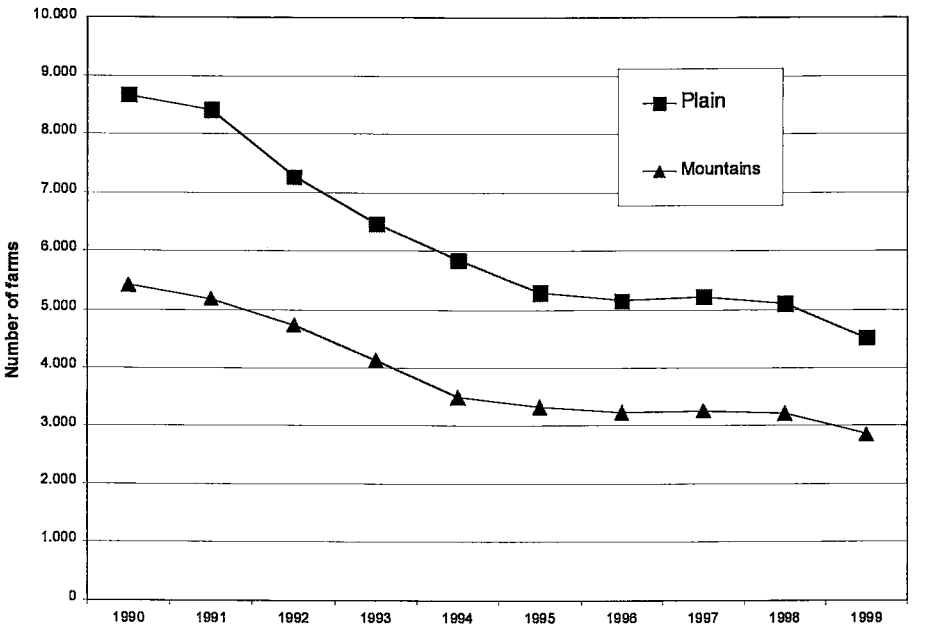
Source: Developed by CRPA on data from the 4th Census of Agriculture (ISTAT 1991)

In terms of the number of cows, the proportional share of the category with 10 to 19 cows fell by 7.6 percentage points in 1990 as against 1982. On the plain, the first two categories here lost importance both in terms of

farm numbers and numbers of cows. In terms of farm numbers, the greatest growth has been in the number of medium-sized farms. However, large farms show the greatest percentage increase in the number of cows.

This analyses confirms the fact that the farming structure in the Parmigiano-Reggiano area, while still in evolution, is based increasingly on medium-sized farms, in both plain and mountain districts. This kind of farm, run as a family business, is able to provide a reasonable income. The large farms have increased their relative position in the area as a whole, but the speed of this development is much less marked.

Figure 5.1 Decline of the number of PR dairy farms 1990-1999



Source: Developed from data from Consorzio Parmigiano-Reggiano

The data taken from the last two censuses provides us with a fairly precise picture of the structural changes that have taken place in the 1980s. The next agricultural census will be held in 2000. In discussing the developments relating to the number of dairy farmers in the 1990s, we will refer to data provided by the Consortium of Parmigiano-Reggiano cheese. According to these data almost 50 percent of the dairy farms delivering milk to Parmigiano-Reggiano cheese dairies closed down between 1990 and 1999. The reduction in the number of farms has affected both altitude zones equally. It should be noted, however, that there has

been a smaller rate of reduction in the mountains than in other parts of the Parmigiano-Reggiano district.

There has, however, been a considerable drop in numbers throughout the whole eastern part of the Parmigiano-Reggiano area. In the Modena plains, where there was a considerable decrease in the 1980s, the fall continued at a similar rate. In Bologna province to the west of the Reno, farm numbers have also changed significantly. These outlying parts of the Parmigiano-Reggiano district are the most sensitive to reductions in income particularly during periods of market difficulty. They tend to be the first to seek to diversify to alternatives.

Table 5.6 Variations in dairy farm numbers from 1991 to 1999

	Plains	Mountains	Total
Mantova right Po	-49.5		-49.5
Parma	-42.9	-43.0	-42.9
Reggio	-50.4	-46.5	-49.0
Modena	-49.6	-50.8	-50.3
Bologna	-63.7	-57.0	-59.6
Total	-47.9	-47.4	-47.8

Source: Developed from data of Consorzio Formaggio Parmigiano-Reggiano

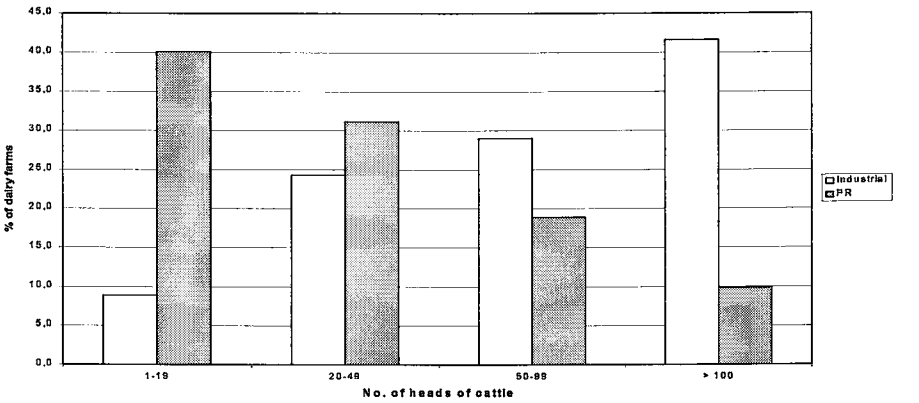
It is quite noticeable that, especially in outlying areas, the number of dairy farms delivering milk for Parmigiano-Reggiano cheese is declining more rapidly than in the more central areas. Two explanations may be given for this phenomenon. First, it can be attributed to the higher productive potential of the soils on the Modena and Bologna plains. This increases production opportunities in these areas and fruit and vineyards are very important alternative crops. A more significant factor, however, is the lower territorial density of dairy farms and cheese dairies in these areas and this does not favour strong and frequent economic and social relations between dairy farmers in the region. Here, Parmigiano-Reggiano cheese is a minority product and local economic and institutional actors are not involved to the same extent as they are the other sub-areas of Parmigiano-Reggiano. In other words the positive externalities of agglomeration are less pronounced and exert less influence on the economic decisions made by local actors. The less frequent reciprocal co-operation between firms because of greater distances and lower 'cultural density' hinders the emergence and subsequent internalisation of external economies.

5.1.5 Production structure of dairy farms producing industrial milk

Within the Parmigiano-Reggiano production area dairy farmers can also produce milk for industrial processing with the advantage that they can use whatever feeding techniques and technologies they chose on their farms. Generally, they deliver this milk to large-scale dairies like Parmalat and Granarolo, that produce a large variety of dairy products including milk for fresh consumption, yoghurt, and fresh cheese.

The statistics produced by the local health authority veterinary services (ASL) make a distinction between farms whose herds are involved in milk production for direct consumption and those where the milk produced is used to make Parmigiano-Reggiano. Almost two-thirds of the industrial milk farms are situated in the lower plains where this type of production is relatively popular. This may be due to the relative abundance of water resources in this sub-area, which makes it possible to cultivated maize silage more easily. In other areas this type of production is insignificant and is limited to isolated examples. The decision to sell the milk for Parmigiano-Reggiano production is almost universal on the farms in the hills and mountains.

Figure 5.2 Cattle herd size distribution of farms producing milk for Parmigiano-Reggiano and farms producing industrial milk



Source Developed from data from the Veterinary Services

One striking fact is the difference in herd-size distribution between the two types of dairy farms. The industrial dairy farms tend to be much bigger than the Parmigiano-Reggiano farms. Over 40 percent of the cattle raised on industrial farms are kept in herds of more than 100 head per farm.

A comparison of dairy farms and their productive capacity also highlights a number of factors generally characteristic of farms producing industrial milk. In the lower plains, this type of production is a relatively widespread choice and even involves medium-size farms and farms very similar in size to those producing milk for Parmigiano-Reggiano. Elsewhere those farms choosing to supply industrial milk have significantly greater productive potential than the local average. This explains why 18 percent of the farms situated in the area are able to supply almost 50 percent of the milk for direct consumption in the province.

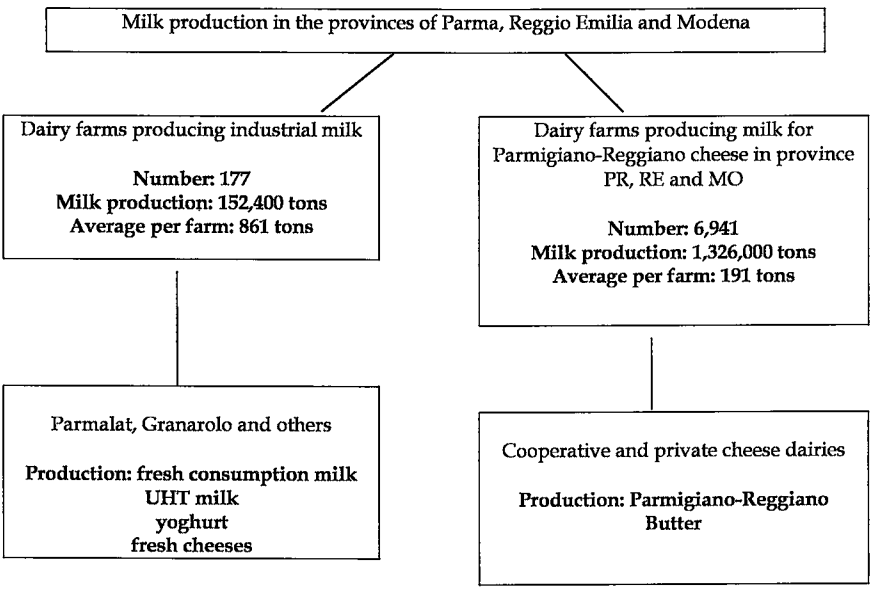
Figures that distinguish dairy farms on the basis of their production orientation are available for the three main producing provinces Parma, Reggio Emilia and Modena. Together these provinces represent 86 percent of the total quantity of milk produced in the Parmigiano-Reggiano production area. Their total milk production was 1,48 million tons in 1998. Of this only 10.3 percent was intended for industrial processing while 89.7 percent went into the production of Parmigiano-Reggiano cheese. As we have seen the dairy farmers who produce industrial milk are generally the large to very large farmers. On average they produce 861 tons of milk. This compares with the 191 tons of milk produced on Parmigiano-Reggiano dairy farms. If we suppose an average milk yield of 7,000 kilo per cow for the first farm type and 6,000 kilo per cow for the second farm type the average herd sizes are 123 and 32 milking cows respectively. In figure 5.3 the milk production and the number of dairy farmers is given for these two production destinations.

Within the Parmigiano-Reggiano production area only three percent of dairy farmers produce milk for industrial processing. Although this type of milk receives a lower price, lower production costs may also induce farmers to switch over to this type of farming system. During price crises some farmers do change, abandoning the Parmigiano-Reggiano cheese dairy and turning to industrial milk production. The natural preconditions for producing industrial milk within the Parmigiano-Reggiano area are not as favourable as the conditions on the other side of the Po. Humid clay soils, for example, are not very suitable for producing maize silage which is an important factor in keeping down the cost of producing industrial milk.

A second reason for the small number of industrial milk producers is related to the presence of transaction costs. Before a switch-over can be made, new commercial relations have to be established and new technologies acquired. These changes inevitably generate transaction costs, which may be sufficiently high for many Parmigiano-Reggiano dairy

farmers to decide against switching to industrial milk production. It is therefore understandable that industrial dairy farms should be much larger than Parmigiano-Reggiano dairy farms. Only large farms are able to exploit economies of scale to such an extent that they can achieve sufficiently low production costs to keep them competitive in the industrial milk market.

Figure 5.3 Milk supply chains in the Parmigiano-Reggiano production area, 1998



Source: Data by CRPA from Consorzio Parmigiano-Reggiano and Veterinary Services ASL

5.2 Productive structure of the cheese dairies

In 1998, Parmigiano-Reggiano cheese was being produced in 612 cheese dairies. Each of these dairies was quite independent. It collected the milk from the dairy farmers and sold the cheese to the buyers who offered the highest price. There are no entry barriers for cheese dairies, although of course the dairy has to be located within the production area.

Although there is no official register for dairy farmers certifying the status of the farmer producing milk for Parmigiano-Reggiano cheese, all the cheese dairies have to adhere to the Consortium. This assigns a registration number to each cheese dairy and the number remains unchanged until the dairy closes down. Each form of Parmigiano-Reggiano cheese carries this identification number, which makes it possible to locate any particular cheese dairy if the need arises. This kind

of 'production authorisation' does not act as a real entry barrier, because it can be granted to anybody who makes a request. The only condition is that the dairy should follow the product specification for Parmigiano-Reggiano cheese[4].

Despite the lack of barriers to entering the chain, the number of cheese dairies is declining and for decades no new registration numbers have been added. The constant effort to exploit economies of scale in processing milk to Parmigiano-Reggiano explains this declining trend. This does not mean that no new actors have come into the picture. During the last five years in particular economically weak cheese dairies have been bought up by private cheese maturing companies which produce and market Grana Padano cheese in cheese dairies to the north of the Po. It is still not a common phenomenon, but it is interesting to note because the production and maturing of Parmigiano-Reggiano cheese has been performed by separate actors for a very long time.

Two indicators of considerable importance in the Parmigiano-Reggiano production cycle can be identified. These are independent of the actual quantities concerned:

1 The quantity of cheese produced correlates almost exactly with the quantity of milk produced. Indeed, the legal structure of the cheese dairies, the overwhelming majority of which are co-operative associations of farms, makes it difficult for them to refuse milk supplied by members. In addition, the cheese dairies, equipped as they are for the sole production of Parmigiano-Reggiano, (and butter) are not able to process the milk in any other way.
2 These factors of almost mechanical cause and effect mean that the Parmigiano-Reggiano production cycle lacks flexibility in that the only alternative outlet for dairy farmers is to supply milk for direct consumption. Even this alternative offers limited flexibility and is, in any case, somewhat illusory. In the first place, there are absolute quantitative limits, i.e. the EU quotas, for this production outlet. The most important consideration though, lies in the fact that although it is relatively easy for farmers to leave Parmigiano-Reggiano production, if they wish to re-enter it later they will have to go through a lengthy period of re-adaptation. The cheese dairies have no choice. Either they continue to produce Parmigiano-Reggiano or they close down altogether. Indeed, the specific character of their spatial organisation, the technology they use and the professional skills employed, is such that they can only be used for a single kind of activity.

5.2.1 The productive structure

In 1998, there were 612 Parmigiano-Reggiano cheese dairies, a reduction of 29 percent on the1990 total. In 1970, there were 1652 cheese dairies making Parmigiano-Reggiano. An analysis of this trend over a 20-year period shows that the number of cheese dairies has been falling at an annual rate of 2.68 percent. In the more recent past the 'mortality' rate for cheese dairies has been around five to six percent per year.

In the last twenty years the quantity of milk processed into Parmigiano-Reggiano has increased by 2.13 percent per annum, from more than 900,000 tons of milk at the beginning of the 1970s to over 1.6 million tons in the early 1990s. Given that this high rate of increase is influenced by the Vernengo certification[5], we must consider the two phases, pre- and post-1984, separately. During the first period, milk production remained relatively stable and around 950 thousand tons of milk was processed each year. From 1984 onwards there was a sustained increase in the volume produced rising from 1.3 to 1.6 million tons each year. The combined effect of these trends has led to a general increase in cheese dairy size. In the early 1970s, the average amount of milk processed by a single dairy was less than 600 tons a year. In the 1990s, more than 2,000 tons of milk was being processed annually.

These factors have lead to a significant process of modernisation in the cheese-making sector. Whilst it still maintains its artisan character, with a widespread presence over the production area, the size of these small businesses has gradually taken on a dimension unique in the history of Parmigiano-Reggiano production. This feature is graphically illustrated by the fact that when the average figures for the Parmigiano-Reggiano district are compared, production from one present day cheese dairy is equal to the combined production of three dairies in the 1970s. The average size of Parmigiano-Reggiano cheese dairies in 1998 corresponded to a processing capacity of 2,570 tons of milk per year. There is a fairly wide variation around this average. It should be said, however, that 65 percent of the milk converted into Parmigiano-Reggiano is processed in cheese dairies whose annual production varies between 1,000 and 4,000 tons. Dairies of this size represent 73 percent of the total in the production district. Fifteen percent of the dairies process less than 1,000 tons and these do not even account for four percent of the total milk processed. On the other hand, those exceeding 4,000 tons, that is 12 percent of the cheese dairies, account for 31 percent of production.
This diversity in the structure of production is influenced greatly by the area in which the cheese dairies are located. The fundamental differentiating factor remains topography. On the plain, 76 percent of milk

is processed in dairies with a capacity of over 2,000 tons. On closer examination it will be seen that the production percentage passing through the hands of dairies exceeding 4,000 tons is 38 percent, while those producing less than 1,000 tons account for just two percent of production. By contrast, in the mountains, dairies producing less that 1,000 tons account for almost 10 percent of production, the majority (43 percent) being concentrated in the 1,000 to 2,000 tons bracket.
In 1998, a mountain cheese dairy processed almost 1,920 tons of milk on average each year. This can be compared to an average of 2,870 tons for dairies on the plains. This difference is not merely the random result of a mathematical division, but a constant that is consistently found even when looking at particular areas in greater detail. In the Province of Parma, the average figure for mountain dairies turns out to be 2,140 tons against 2,650 tons on the plain. In the Province of Reggio, the mountain average is 2,100 tons as against 2,850 tons for the plain. In the Province of Modena, the figures are 1,630 tons and 2,910 tons respectively.

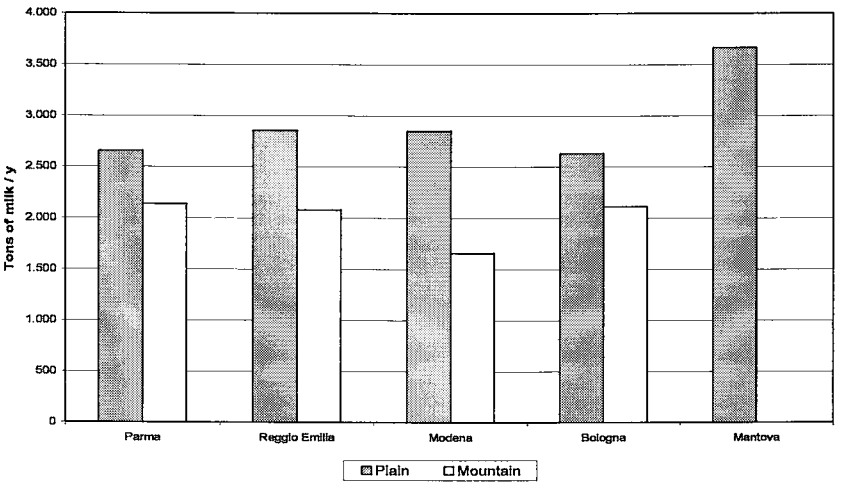
It can be seen, therefore, that the relative sizes revealed by these data show that dairies in the mountainous areas rarely exceed a processing capacity of 3,000 tons per year. Indeed, not even ten percent of mountain cheese dairies fall into this size category. On the plains, the typical processing capacity of a cheese dairy is about 2,900 tons, while 40 percent of dairies actually exceed this capacity.

There are similar differences in the dimensions of cheese dairies as between the different provinces making up the Parmigiano-Reggiano production district. The biggest cheese dairies are to be found in Mantua that has an average milk processing capacity of more than 3,700 tons per year. Reggio follows with 2,640 tons, Parma with 2,520 tons, Bologna with 2,370 tons and Modena with 2,200 tons. It is true that these particular differences are partly due to the varying amounts of mountain land in the different provinces. However, it should not be forgotten that, even when restricting the comparison to areas with similar characteristics – that is plain lands - Mantua still prevails over Reggio (2,850 tons), Parma (2,650 tons), Modena (2,900 tons) and Bologna (2,630 tons).

The larger size of the cheese dairies in the province of Mantua to the east of the Po can be attributed to its proximity to the large cheese dairies producing Grana Padano cheese on the other side of the river. The process of restructuring and the continuous enlargement of the dairies in this part of the Parmigiano-Reggiano district might be influenced to some extent by the dairy structure of Grana Padano production, a kind of imitation effect. Grana Padano dairies vary in average size from 5,000 to 20,000 tons of milk a year. Although there is a tension between the quality of

Parmigiano-Reggiano cheese and the size of the cheese dairy, the Parmigiano-Reggiano dairies in the province of Mantua may feel they do not want to be left behind by their colleagues on the other side of the Po. The large Grana Padano dairies exude a sort of cultural superiority over the Parmigiano-Reggiano dairies.

Figure 5.4 Average size of cheese dairies according to altitude zone and province - 1998



Source: Developed on data from Consorzio Parmigiano-Reggiano

5.2.2 *The organisational structure of cheese dairies*

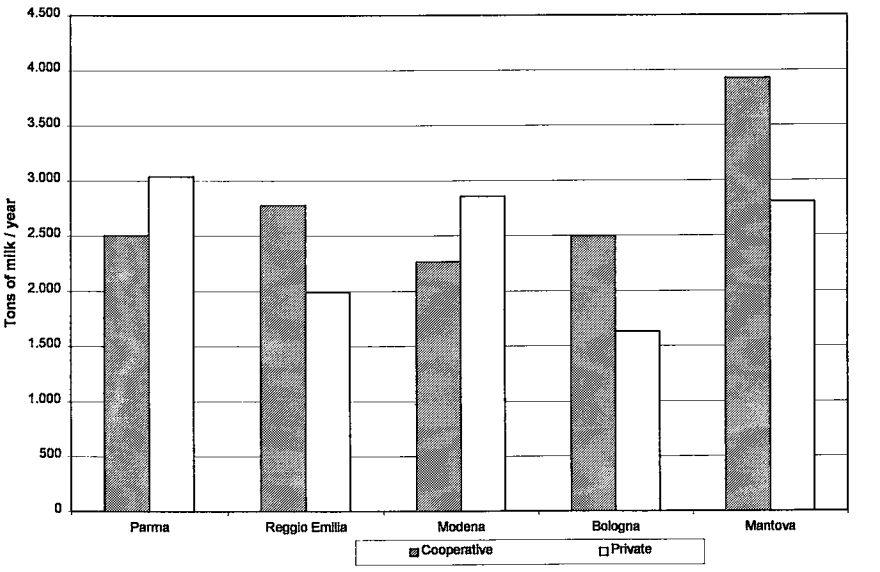
Most cheese dairies engaged in the production of Parmigiano-Reggiano are co-operatives of dairy farmers. They own the cheese dairy and pay the cheese-maker according to the contractual provisions operative in the area. The co-operative owns the cheese until it is sold to the purchaser. The profits from the sale are divided after the processing costs have been deducted. 85 percent of milk for Parmigiano-Reggiano production is processed by co-operative dairies. Co-operative dairies make up 82 percent of cheese dairies in the area.

The remaining 15 percent of the milk is processed by private cheese dairies (12 percent) and cheese dairies run as part of the farm (3 percent). In legal terms, the first category is a trading company in form and process milk bought from local farmers into Parmigiano-Reggiano. The farm-scale cheese dairies though, take milk from a single farm and are part of the farm itself.

In 1998 there were 78 private dairies and 43 farm-scale dairies, representing respectively 14 percent and three percent of Parmigiano-Reggiano production. They can be found in every province in the district and are clearly in the minority. Only in Parma do private cheese dairies have a certain importance, a fact that is related to original land division and land ownership systems. Here they process 25 percent of the milk and make up 21 percent of cheese dairies in business. To understand the nature of the phenomenon better, it should be added that the private Parma cheese dairies alone represent more than half of all private cheese dairies making Parmigiano-Reggiano. Outside the province of Parma the private cheese dairies represent a small minority.

The 43 farm-scale dairies are scattered all over the Parmigiano-Reggiano district and their share in Parmigiano-Reggiano milk production varies between four percent in the province of Parma to one percent in the province of Mantua.

Figure 5.5 Average size of cheese dairy according to typology - 1998



Source: Developed by CRPA on data Consorzio Parmigiano-Reggiano

Finally, it should be noted that private cheese dairies are largely confined to the plains and they are about the same size as co-operative dairies. Private dairies are, however, too small to make it possible for them to be organised on an industrial scale. Indeed, when their operational size is

examined, it can be seen that, on average, they are only slightly bigger than the co-operative dairies. In 1998, private dairies processed 2,770 tons of milk on average each year. This can be compared to the 2,650 tons processed by the co-operative dairies. Such differences are apparent in all the provinces with the exception of Parma, where, as we have already seen, the private dairy has a more important position. Here the average capacity of private dairies is 3,030 tons a year, compared to the 2,500 tons capacity typical of co-operative dairies. It is, however, important to stress that private dairies are not simply larger counterparts of the co-operative dairies, as might appear at first sight. The differences in firm behaviour between the two types of dairies will be analysed in Chapter 9.

5.3 Second step co-operatives

During the long history of the Parmigiano-Reggiano various attempts have been made, mainly by co-operatives, to enter in the cheese maturing and marketing business. Most of these efforts have not been very successful. The most significant example remains the '*Latterie Cooperative Riunite di Reggio Emilia*' (United Cooperative Cheese Dairies), which was founded in 1934, but declared itself bankrupt under the name 'Giglio' in 1994. This so-called 'second step' co-operative [6] brought together most of the co-operative cheese dairies in Reggio Emilia province, so that the cheese delivered by the co-operative production dairies could be matured and commercialised and their cream processed into butter. These dairies had the option of selling through 'Giglio', but were not obliged to do so. Due to its large market share this big co-operative acted effectively as a deterrent against private cheese maturing firms and wholesalers in periods of price crises, as with its purchasing policy it was able to counter these firms preventing too drastic price falls. The price set by Giglio acted as reference price for cheese on the market. In the 1990s the firm, which had become a leader in the national Parmigiano-Reggiano market, fell into crises and was purchased by a private dairy company 'Parmalat', which continued the fresh milk and yoghurt branches, but significantly scaled-down Parmigiano-Reggiano activities. The 'Giglio' case has been the most significant example of a second step co-operative active in maturing and commercialising Parmigiano-Reggiano cheese.

Similar experiences can also be identified, but on a more limited scale. The C.L.C. of Carpi aggregated a series of cheese dairies in the province of Modena. It had the same objectives as 'Giglio': collecting butter and maturing and commercialising cheese and bringing it onto the market. Unfortunately this firm also went bankrupt. Today, two second-step co-operatives are still in operation: the *Consorzio Gran Terra* in Modena brings

together 85 cheese dairies and ripens and markets about 400,000 forms of cheese and the *Consorzio Latterie Mantovane di Mantova,* which brings together cheese dairies producing Parmigiano-Reggiano and Grana Padano in the province of Mantua.

5.4 The structure of the maturing firms

Only a minority of cheese dairies are prepared to see Parmigiano-Reggiano through the full 18-24 month of its maturing process. The firms that specialise in this economic activity are important actors in the supply chain and their activity is quite specific. They assume the technical and economic risks of maturing and marketing of the cheese. These firms are also wholesalers and they commercialise the final product. They purchase the cheeses from the cheese dairies when they are about 6-7 months old at which time they are already partially mature.

Two categories of maturing firms can be distinguished:
- Firms effectively purchasing and selling the cheese at their own risk and expense. These are the pure maturing firms.
- Firms that mature for third parties and offer maturing services to firms that do not have their own storage houses.

A very large variety of firms are active at the maturing stage. On the one hand there are the large firms that generally also mature Grana Padano and a few other cheeses and on the other there are the small family firms that mainly specialise in Parmigiano-Reggiano. The overall number of maturing firms oscillates from year to year, but is estimated to be about 220. The economic size of these firms varies considerably. The most important among them have turnovers of between 120-130 billion lire, smaller firms have turnovers of 55-60 billion lire and the smallest around 10 billion lire. These firms have their own cheese maturing houses with capacities that vary from 100,000 forms of cheese in the large firms down a few thousands forms of cheese managed within smaller firms.

Although these firms may have very different typologies, a feature common to them all is that they do not only commercialise Parmigiano-Reggiano cheese. All big cheese maturing firms and wholesalers market both Grana cheeses and many other cheeses. Wholesalers who only market Parmigiano-Reggiano cheese are very rare and are generally very small.

There is not a pronounced level of concentration in these firms. The first four firms account for 27 percent of the total amount of matured cheese

and the first largest 17 firms mature about 40 percent of Parmigiano-Reggiano cheese.

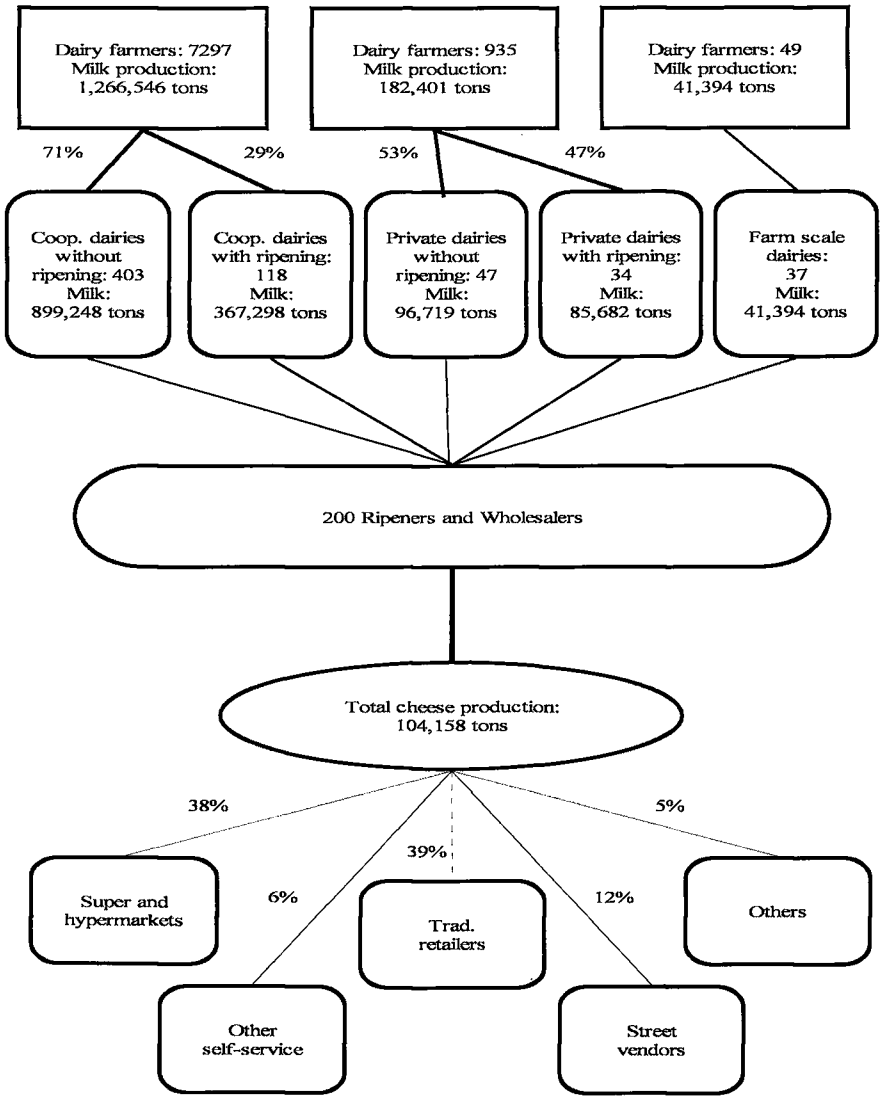
Table 5.7 Level of concentration and diversification of the maturing firms

	Total Turnover of the firm	% of the market of Parmigiano-Reggiano	% turnover in Parmigiano-Reggiano	% turnover in Grana Padano	% of turnover on other grana cheese
	Bn lire	%	%	%	%
1	434	9.8	59.0	41.0	
2	415	4.1	70.0	30.0	
3	291	4.1	35.0	60.0	5.0
4	120	3.7	70.0	30.0	
5	150	2.5	40.0	60.0	
6	344	2.5	20.0	60.0	20.0
7	380	2.3	20.0	70.0	10.0
8	300	1.9	20.0	70.0	10.0
9	48	1.7	80.0	20.0	
10	194	1.5	35.0	55.0	10.0
11	380	1.2	34.0	66.0	
12	45	1.1	90.0		10.0
13	205	0.9	27.0	73.0	
14	78	0.7	20.0	70.0	10.0
15	16	0.6	80.0	20.0	
16	130	0.3	6.0	94.0	
17	72	0.1	5.0	95.0	
Total	3,680	39.0			

Source: Elaborated on data Databank

Within this group of firms two important sub-groups can be distinguished. The first group is composed of firms that mainly mature Parmigiano-Reggiano cheese. Most of these firms are located within the Parmigiano-Reggiano district and they mature Grana Padano only to a limited extent. The second group consists of firms whose main turnover is Grana Padano cheese, but are also involved to a significant degree with Parmigiano-Reggiano cheese as well. They are mainly large firms and are located outside the Parmigiano-Reggiano district. As they are much larger than the other group their absolute interest in Parmigiano-Reggiano cheese may be quite high. Table 5.7 shows that the firms in this second group have market shares in Parmigiano-Reggiano cheeses, which rank them among the first ten firms.

Figure 5.6 Production volumes of actors in the Parmigiano-Reggiano supply chain 1996



Source: Elaborated on data cheese dairy survey and data Consorzio Parmigiano-Reggiano

5.5 Conclusions

This chapter has given an overview of the structure of the farms, cheese dairies and maturing firms composing the supply chain of Parmigiano-Reggiano cheese production. Common feature of all the firms in the chain is their limited size compared to firms operating in chains of other dairy products in Italy and in Europe. Although the maturing firms have considerably higher turnovers than the cheese dairies, which creates an skewed distribution of market power in the chains, still their size is small in comparison with the industrial multi-product dairy companies. In the following figure product volumes are estimated for the actors described in this chapter. The quantities of cheese marketed through the different market outlets has already been put into the figure, but will be dealt with in more detail in the next chapter. The data in the figure refer to 1996, as only for this year all the different data sources were available. The vertical and horizontal market relationships between the actors of the chain and the firm behaviour will be analysed in Chapter 9.

Notes

[1] The interprofessional quality control body in which all the actors are represented. Its role will be described more in detail in par.7.1.

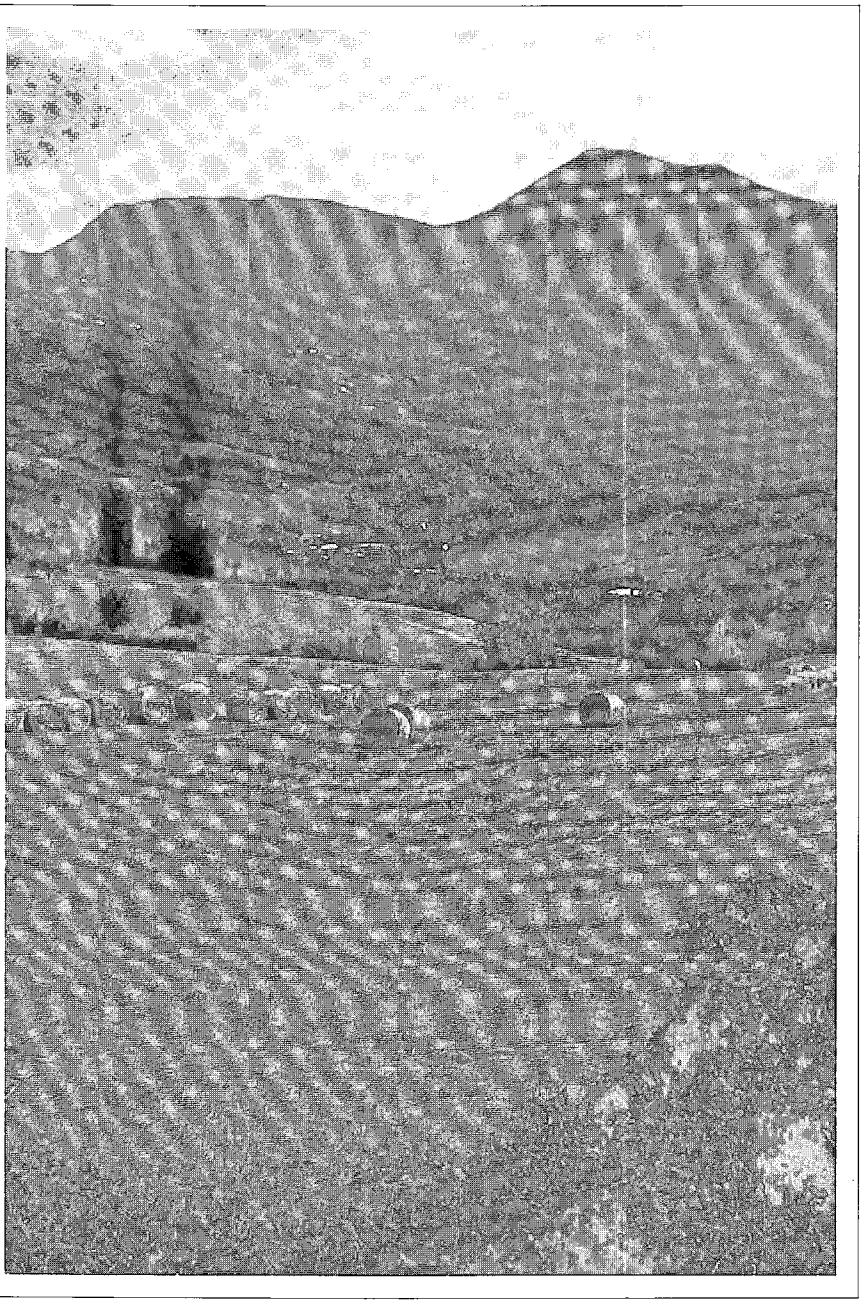
[2] An exception is the regulation for Grana Padano cheese, which poses some limits to the use of industrial by products. It is however not exaggerated to say that the technology of the dairy farms delivering milk to Grana Padano cheese is much more similar to industrial dairy farms than to PR dairy farms. In the following analyses therefore no distinction will be made between GP dairy farms and industrial dairy farms.

[3] To this respect the autonomous regions of Valle d'Aosta should be mentioned where the share of public assistance to income arrives at more than 50 percent and enables in this way the maintenance of dairy farming in very adverse pedological conditions (Antonello *et al.* 1997)

[4] Up to 1995 a certain entry barrier existed, but only in a indirect way as the Consortium imposed production quotas to each cheese dairy in order to regulate the supply of cheese on the market. New cheese dairies could not entry in production if they were not provided with a cheese quota. When the National Anti-Trust Agency prohibited these cheese quantity control measures of the Consortium there are formally no barriers for a cheese dairy to enter the chain. A more detailed analysis of this aspect will be dealt with in Chapter 7.

[5] Vernengo formerly was the cheese produced in winter time in the period of the 11th of November till the first of April. In that time only the cheese produced between the 1st of April and the 11th of November could be called Parmigiano-Reggiano. From 1984 this distinction has been abolished and all the cheese produced during the whole year may be called Parmigiano-Reggiano. Vernengo was in that time cheese of a secondary quality.

[6] A 'second step' co-operative is an aggregation of cheese producing co-operatives. The board of the second step co-operative is composed of the chairmen of the producer's co-operatives.



6 Market Characterisation of the Product

6.1 Some general characteristics of the Italian milk market

The most important areas of milk production are to be found in the temperate climate zones of Europe, where regular and abundant rainfall guarantees low cost roughage production. It is therefore quite surprising to find Italy, which falls mainly within the Mediterranean climate zone, at number five on the EU's list of milk producers. This position has been reinforced to some extent as most EU member states reduced milk production significantly following the imposition of milk quotas.

Italian milk production is concentrated in the northern regions of the country, where the climate is more continental. The first three regions, Lombardy, Emilia-Romagna and Veneto, account for two-thirds of total milk production. In these regions quite different production systems can be distinguished. Relatively cold winters alternating with hot dry summers characterise part of the Po Valley, whereas the Alpine mountains receive significant rainfall even in the summer months. This type of climate does not make it possible for dairy farmers to rely on pastures. Outside the Parmigiano-Reggiano district maize silage is economically the most convenient forage crop and within the area drought resistant alfalfa, a crop notoriously unsuitable for pasture, is dominant. All dairy farms on the plains apply a zero-grazing system.

Although milk production is substantial, it is not enough to satisfy the national demand for dairy products and within the EU Italy is the major importer of dairy products. In terms of milk equivalents[1] about 42 percent of usable production comes from abroad, particularly from Germany and France. A second characteristic of the Italian dairy industry is the high proportion of milk destined for cheese production. Over 60 percent of usable production is transformed into cheese each year. If we consider that imported milk is mainly used for the liquid milk sector (UHT and the fresh milk market) we estimate that almost 75 percent of national milk production is destined for cheese production. When compared to other

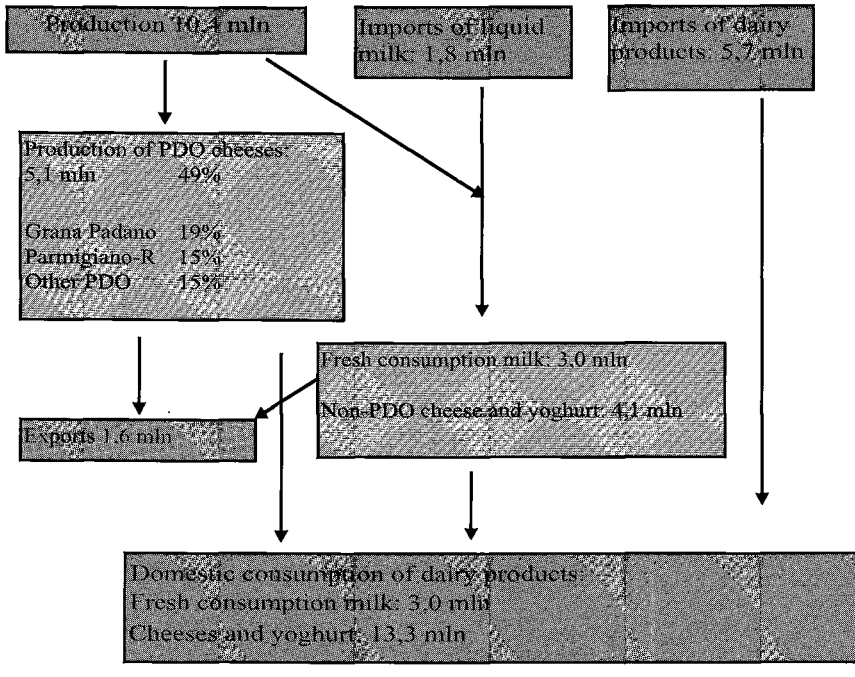
EU member states it becomes clear that Italy converts the largest proportion of milk into cheese. This has important consequences for the valorisation of milk on the market.

Table 6.1 Milk production in Italy 1997/98

	000 ton	%	Cum %
1. Lombardy	3,982	37.9	37.9
2. Emilia-Romagna	1,817	17.3	55.2
3. Veneto	1,182	11.3	66.5
4. Piemonte	858	8.2	74.6
5. Lazio	454	4.3	78.9
6. Puglia	292	2.8	81.7
7. Campania	278	2.6	84.4
8. Sardinia	210	2.0	86.4
9. Sicily	165	1.6	87.9
10. Other regions	1,367	12.0	100.0
Total	10,503	100.0	

Source: ISTAT/UNALAT

Figure 6.1 Supply balance of dairy products in Italy 1996 (in million tons of milk equivalents)



Source: Developed from data from Osservatorio Latte

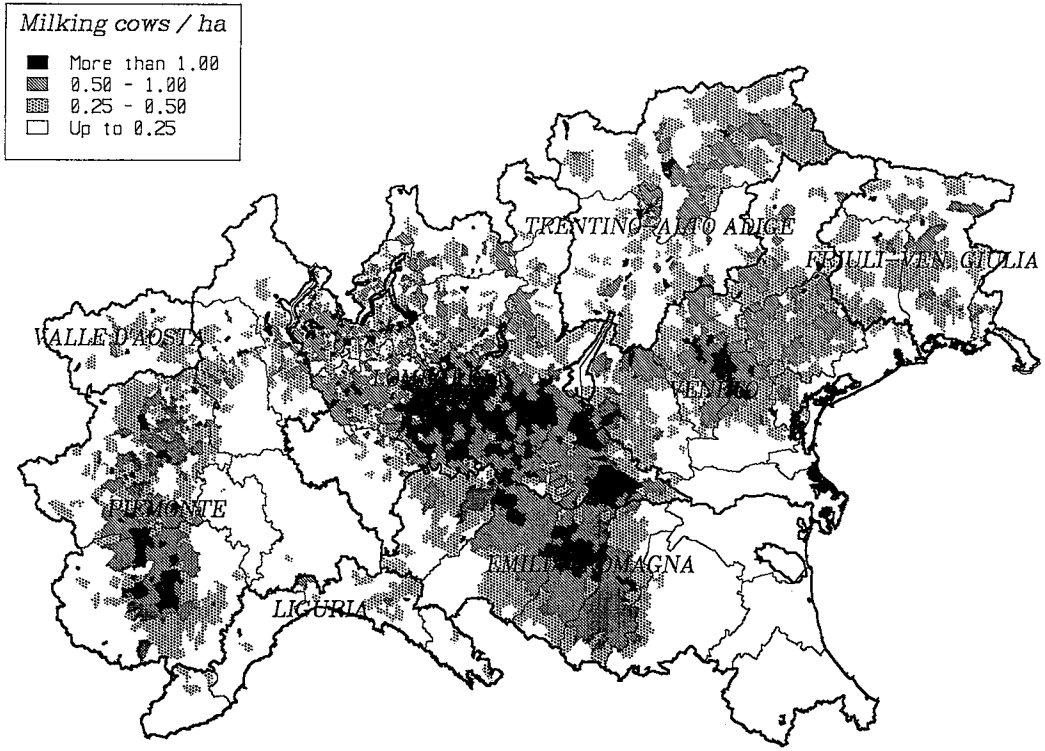
Among the various types of cheese produced - and a recent survey counted more than 400 different types being produced in Italy at the moment (INSOR 1991) - cheeses with a Protected Designation of Origin (PDO)[2] occupy a very significant position. Only milk produced in defined production areas may be used to make these cheeses. Almost 50 percent of the milk processed into cheese has a national PDO label. The most important cheeses are two typically hard cheeses Grana Padano and Parmigiano-Reggiano. These absorb about 19 percent and 15 percent of Italian milk production respectively (see figure 6.1). As has been described in Chapter 4 the Parmigiano-Reggiano is only produced in the Emilia-Romagna region and in a small part of Lombardy (Mantua east of the River Po). Grana Padano, on the other hand, is produced over a much larger area extending from Piemont near the French border to Veneto. The third PDO cheese, the well-known Gorgonzola, is mainly produced in the eastern part of Piemont and the northern part of Lombardy in the vicinity of the Alpine lakes Lago Maggiore and Lake Como. Provolone was originally a southern cheese, but is now found extensively in the Lombardy region of the Po Valley. This cheese, which has only recently attained PDO status as Provolone Padano, is produced in small-scale processing plants and is coupled to the production of Grana Padano. Depending on market conditions, milk is directed to one cheese or the other. Asiago and Montasio both originate in north-east Italy. They too have recently been branded PDO products and production statistics indicate that this recognition has favoured their market position. Finally the Fontina, a typically Alpine mountain cheese should also be mentioned because it contributes significantly to the dairy economy of the Valle d'Aosta region (for detailed production data see table 6.3)

6.2 Development of cheese production in Italy

In the 1990s, the total amount of cheese produced from cow and ewe's milk has increased almost continuously. Between 1993 and 1998 production has risen by 8.8 percent. Not all types of cheese have grown at the same rate. The strongest growth rate has been amongst the 'Grana' cheeses, of which Parmigiano-Reggiano and Grana Padano are the most important representatives. Between 1993 and 1998 production increased by 36 percent. All other types of cheese have either remained at a stable level of production or have lost some of their market.

DISTRIBUTION OF DAIRY FARMING IN NORTHERN ITALY

– 1990 –



Elaborated by Centro Ricerche Produzioni Animali (C.R.P.A.) Reggio Emilia (Italy) on data ISTAT

As far as the group of PDO cheeses are concerned, their weight in the total market increased from 44 percent at the beginning of the 1900s to almost 48 percent at the end of the decade. Almost all PDO cheeses show an upward trend and they are eager to exploit their increasingly positive market image. Consumers in Italy and abroad are demanding an increasing amount of regionally specific products (Van Ittersum *et al.* 1999).

Table 6.2 Production of cheeses by category in Italy (in thousand tons)

	1993	1994	1995	1996	1997	1998	% var. 98-93
Hard cow milk cheese	185.9	194.6	223.2	240.1	240.8	253.6	+36.4
Hard ewe milk cheese	69.1	70.6	74.9	70.3	62.4	62.3	-9.8
Semi-hard cheeses	84.1	80.0	79.8	76.0	74.0	73.5	- 12.6
Soft cheeses	117.5	117.1	115.6	115.4	119.3	118.7	+1.0
Fresh cheeses	326.5	338.3	338.0	336.8	341.0	345.8	+5.9
Goat milk cheese	7.2	7.5	7.0	6.5	6.5	6.0	-16.6
Other cheeses	39.6	40.4	41.0	42.3	41.3	43.4	+9.5
Total production	829.9	848.5	879.5	887.5	885.3	903.3	+ 8.8
- thereof PDO cheese	374.4	393.8	417.5	425.0	414.4	431.2	+15.2
% PDO cheeses	45.1	46.4	47.5	47.9	46.8	47.8	

Source: Osservatorio Latte

In addition to PDO cheeses, soft cheeses are also enjoying a growing amount of market interest. These cheeses are industrial products and are also produced with imported milk. They have built up an image associated with freshness and the presumed leanness of the product.

Table 6.3 Production of PDO cheeses in Italy (in tons)

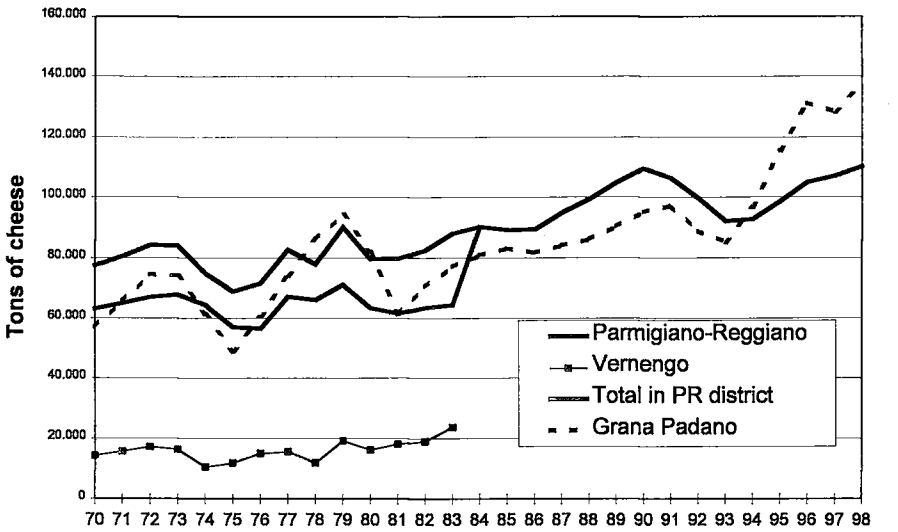
	1993	1994	1995	1996	1997	1998	% var.98-93
Grana Padano	85,078	96,638	115,492	131,204	128,283	137,478	+61.6
Parmigiano-Reggiano	92,056	92,708	98,522	104,919	106,984	110,128	+19.6
Gorgonzola	39,656	40,325	40,925	42,394	41,303	43,394	+9.4
Pecorino Romano	36,072	36,100	38,431	35,349	38,360	34,317	-4.9
Provolone Valpadana	23,513	27,400	24,500	24,205	22,430	22,708	-3.4
Asiago	18,046	19,078	19,495	19,521	19,605	19,678	+9.0
Mozzarella i Bufala	13,000	13,000	16,000	15,000	16,000	17,000	+30.8
Taleggio	12,500	10,700	10,900	10,900	10,055	10,400	-16.8
Montasio	8,157	8,145	9,478	9,691	8,782	9,168	+12.4
Fontina	4,000	3,736	3,994	4,590	4,598	4,556	+13.9
Other PDO	46,723	48,269	41,155	28,456	19,271	23,640	-49.4
Total	374,458	393,814	417,470	425,020	414,398	431,235	+15.2

Source: Osservatorio Latte

6.3 Market characterisation of PR cheese

The production of Parmigiano-Reggiano cheese, although subject to cyclical fluctuations, has been growing continuously in recent years. In the 1950's production oscillated at around 45,000 tons. By the 1970s it had risen to 65,000 tons. This level of production remained stable until 1984, the year in which it was decided to brand the winter cheese production, previously known as Vernengo, as Parmigiano-Reggiano. This decision resulted in an increase in the total production of Parmigiano-Reggiano and output rapidly reached 90,000 tons. A maximum of 109,427 tons was produced in 1990, but as this quantity could not be absorbed at remunerative prices by the market, production subsequently decreased. By 1994/ 1995 this price crisis had been overcome and production immediately began to expand. In 1998 it reached 109,783 tons, a maximum that again generated a severe price crisis.

Figure 6.2 The production of grana cheeses in Italy, 1970–1996



Source: Developed from data Consorzio Grana Padana and Consorzio Parmigiano-Reggiano

Although at first glance the market for Parmigiano-Reggiano cheese is the general cheese market, the more relevant market is the market for 'grana' cheeses. These are cheeses that are used grated on the pasta, the first course of the Italian meal. The name 'Grana' cheese derives from the granular composition of this group of hard cheeses. Parmigiano-Reggiano

has two important competitors in this market: Grana Padano cheese and the other Grana cheeses. In general these Grana cheeses are lower priced.

Pecorino Romano should also be mentioned here. This is an important ewe's milk cheese produced mainly in Sardinia and Central Italy. Although Pecorino is not a Grana cheese it has to be considered an important competitor of Parmigiano-Reggiano, particular on the markets of Central and Southern Italy where it is also grated on the pasta. Pecorino has a sharper taste then Parmigiano-Reggiano cheese and this characteristic is particularly appreciated by consumers in the South.

Looking again at the production figures for Grana cheeses we notice that increased Grana cheese production can mainly be attributed to Grana Padano. When production figures for 1998 are compared to those for 1993, we see that production of Grana Padano increased by 61 percent in this period while Parmigiano-Reggiano production increased by 19 percent. This enormous increase in Grana Padano production, however, could not be absorbed by the market at remunerative prices. Whilst domestic consumption of both Grana cheeses gradually increased during the eighties, there was a gradual slowing down of expansion after 1990. In the 1990s the export market also began to grow and this continued steadily. Grana Padano has been more successful on exports markets, favoured by its lower price and its capacity to exploit the image of Parmigiano-Reggiano cheese on the foreign market.

Grana cheeses are exported either to countries where Italians and their descendants are strongly represented (Switzerland, USA, Germany) or where the Italian food style or more generally the Mediterranean diet has become fashionable (France and Great Britain).

Table 6.4 Exports of Grana cheeses (in tons)

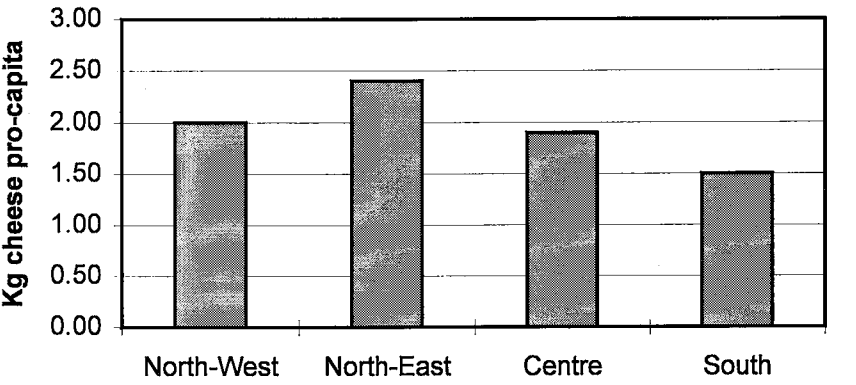
	1991	1992	1993	1994	1995	1996	1997	1998	% var 98-91
Switzerland	3,440	3,640	4,290	4,480	4,470	4,694	5,002	4,911	+42.7
USA	1,850	2,260	3,650	2,780	2,630	3,543	3,568	3,610	+95.1
Germany	1,890	1,960	1,980	2,110	2,340	2,924	3,334	3,655	+93.3
France	1,130	1,180	1,570	1,700	2,110	2,412	2,243	2,432	+115.2
Great Britain	750	760	950	1,130	1,160	1,422	1,771	1,971	+163.3
Other countries					5,644	5,529	5,985	7,307	
Total exports					18,354	20,524	21,903	23,886	

Source: ISTAT

6.4 Cheese consumption

In Italy, per capita consumption of cheese is about 13.5 kilo per year. Hard cheeses such as the grana cheeses and Pecorino Romano account for 17 percent of this total. The pro-capita consumption of grana cheeses in Italy is 2.3 kilo a year. This general picture, however, conceals considerable regional differences in consumption patterns[3]. The statistical distribution, by area, of Parmigiano-Reggiano consumption is set out in the graph below (see Figure 6.3).

Figure 6.3 Consumption pro capita of grana cheeses

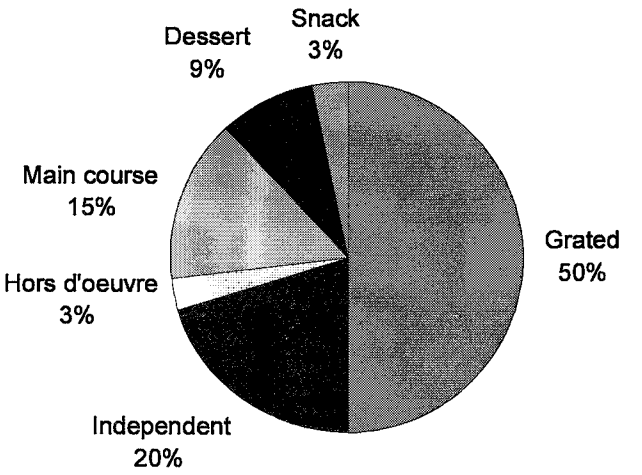


Source: Annuario Latte 1996 cit. page 358, AIA, Unalat

The area of highest Grana cheese consumption is north-east Italy. This includes the regions of Emilia-Romagna and Veneto which are both important in Parmigiano-Reggiano and Grana Padano production (2.4 kilo per capita). The north-west, including the regions of Lombardy and Piemonte and central Italy, including Tuscany, Umbria and Lazio have similar consumption levels (2.0 and 1.9 kilo respectively). In southern Italy Grana cheese consumption is somewhat lower, on average 1.5 kilo, due mainly to strong competition from Pecorino cheese[4].

More recent information specific for Parmigiano-Reggiano brings evidence of a stronger consumption among consumers in higher income groups. A consumer survey carried out among 911 Italian consumers reveals that the users of PR cheese are more present in the higher income groups than the non-users (Van Ittersum and Candel 1999)

Figure 6.4 Way of consumption of Parmigiano-Reggiano cheese



Source: Annuario Latte 1996, AIA, Unalat

6.5 Description of the consumption and marketing system

We know, thanks to the famous reference in Boccaccio cited in Chapter 2, that Parmigiano-Reggiano has been used in grated form since the fourteenth century. It is still the most important way the cheese is used (50 percent). Parmigiano-Reggiano cheese is strongly connected with Italian gastronomic traditions and this explains the seasonal nature of consumption: higher during winter months when meals requiring more complex preparation are more frequent.

As we have seen above, the most Parmigiano-Reggiano cheese is consumed within the production area itself. Here the product plays an almost daily role in the local gastronomic culture. More broadly speaking, it is a part of the local culture. Outside the production area, where competition with other grana cheese is strong, the product is, according to Torelli (1995):

a considered by consumers to be an authentic food product;
b a product which confers a certain distinction both on the person eating it and on the person offering it;
c a product that has great intrinsic quality, to be found above all in its flavour.

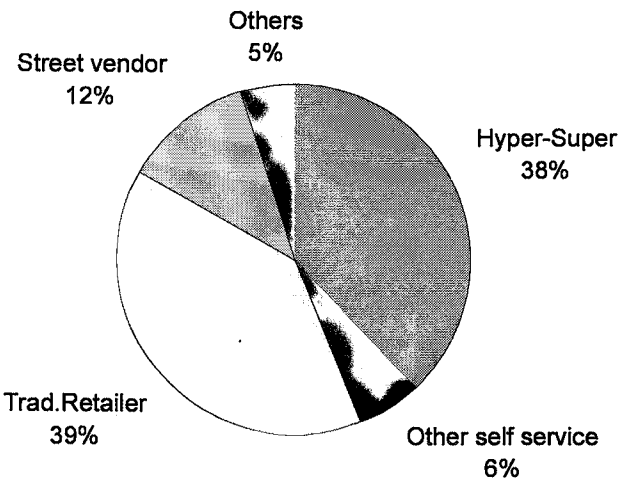
The negative aspects are as follows:

a it does not fit in well with slimming diets;
b it is expensive.

In a market research project carried out on a sample of 112 shops which included both small- and large-scale retailers, sales managers stated that only 48 percent of consumers considered that the price of Parmigiano-Reggiano was 'reasonable' and 41 percent considered it 'expensive' or 'too expensive'. In contrast, the price of Grana Padano as considered 'reasonable' by 60 percent of consumers and 'expensive' or 'too expensive' by 26 percent (Ravazzoni and Schianchi 1992).

It is interesting to see that consumers appreciate the positive aspects of Parmigiano-Reggiano (health, quality, status) more than they do the qualities of other competing hard cheeses (Grana Padano and Pecorino). The only draw-back remains price. This attitude is borne out by consumer behaviour. If sales of Parmigiano-Reggiano are analysed in terms of the socio-economic status of the consumer, it will be seen that the lowest social group buy 23 percent of the cheese sold. Corresponding percentages in the same group for purchases of all Italian designation of origin cheeses are 28 percent and 30 percent for purchases of Grana Padano (ISMEA 1996). Research has also shown that the preference for Parmigiano-Reggiano becomes stronger as the area of consumption is close to the area of production (north-east Italy). In the north-west, however, the image of Grana Padano competes strongly with that of Parmigiano-Reggiano. This means that the two main Italian Grana cheeses each have more positive associations for the consumer the closer the area of consumption comes to the area of production.
Sales outlets for Parmigiano-Reggiano are set out in the next graph.

Figure 6.5 Sales outlets of Parmigiano-Reggiano cheese



Source: Torelli 1995

Traditional ways of selling Parmigiano-Reggiano including street vendors and small retailers are still the most important sales outlets (51 percent) for end consumers. Over time, however, large-scale sales distribution networks have gained considerable ground and today 44 percent of total sales pass through these channels – this figure also includes purchases in self-service shops. Direct sale by dairies to the end consumer, hidden within the statistical category 'other outlets' account for no more than five percent. Evidently this type of sales outlet is strong within the production area where a considerable number of consumers buy cheese directly from one of the six hundred cheese dairies. These often have a small shop for direct sales.

Empirical market research based on sample surveys agree on two factors:

1 The proportion of Parmigiano-Reggiano sales made through large-scale distribution sales outlets continues to grow.
2 Of the various Italian hard cheeses, Parmigiano-Reggiano continues to provide the greatest 'resistance' to mass sale through the large-scale commercial distribution networks and thus leaves considerable space for traditional, small-scale retailer selling from a single shop or for travelling salesman[5].

This 'resistance' is strong enough to effect the way in which the cheese is sold to the public.

Table 6.5 Sales modalities of grana cheeses in 1998

	Parmigiano-Reggiano	Grana Padano	Other grana
Fresh cuts	81.8	73.3	53.5
Packed	18.2	26.7	46.5
Total	100.0	100.0	100.0

Source: Developed from data from Osservatorio Mercato Parmigiano-Reggiano

More than 80 percent of Parmigiano-Reggiano is supplied to the end consumer in the form of fresh cuts. These have a minimal weight of about one kilo and are cut from the whole cheese at the time of sale. Only 18 percent of Parmigiano-Reggiano is sold to the consumer in pre-packed portions. Grana Padano cheese and other Grana cheeses are more frequently sold as pre-packed products which reflects their more industrial and large- retailer friendly sales strategy.

The differences between the three categories of Grana cheese becomes even more clear when we look at the way the packed cheese is sold to the consumer. Three modalities can be met on the supermarket shelves: small,

vacuum packed pieces ready for grating (about 200 grams each), small bags of grated cheese and small packed pieces for snacks.

Table 6.6 Sales modalities of packed cheeses in 1998

	Parmigiano-Reggiano	Grana Padano	Other grana
Small vacuum pieces	94.8	75.7	11.3
Grated cheese	4.4	13.6	60.1
Snacks	0.8	10.7	28.6
Total	100.0	100.0	100.0

Source: Developed from data from Osservatorio Mercato Parmigiano-Reggiano

Very small quantities of Parmigiano-Reggiano are sold in bags as grated cheese or as snacks. This type of sale modality is already higher for Grana Padano and is extremely high for 'Other Grana cheeses'. This latter category of Grana cheeses is sold primarily as packaged grated cheese and as pre-packed snacks.

As far as Parmigiano-Reggiano is concerned a significant number of consumers still prefers to have direct control and be present when a section is cut off for him or her from the larger cheese. The purchase of large, fresh cuts allows the consumer to ascertain where the Parmigiano-Reggiano has come from[6]. This is not an unimportant consideration if it is remembered that Parmigiano-Reggiano is bound in the customer's mind with cultural associations of prestige. It is, for example, a product suitable for a present, and as such must be bought in a protected environment that provides the right kind of guarantee of authenticity. When Parmigiano-Reggiano is sold within the setting of a new modern hypermarket, the sales often takes place in a specially designed area, a 'delicatessen' counter, where the public has contact with specialised staff who cut and weigh the portions of cheese at the moment of purchase. In this way the selling 'ritual' associated with Parmigiano-Reggiano remains intact. It is almost the same as that found in traditional retailing shops, even though it is now within a commercial structure which, so far as the rest of the food being sold is concerned, tends to use the lowest common denominator of self service.

The routes followed by Parmigiano-Reggiano from the producers to the end point of sale are not always identical. Purchasers within the large-scale distribution sector generally buy from the maturing firms (73 percent) and, to a limited extent, directly form the cheese dairy, as these are not able to deliver large quantities. So far as traditional retailers are concerned 36 percent deal directly with the producers when buying Parmigiano-Reggiano. It is likely that such methods become more practicable as the distance between production and consumption areas

decrease. In the traditional retail trade supply by wholesalers remains important. Thirty-two percent of retailers buy from specialist wholesalers while 21 percent go through non-specialist suppliers. The specialist ripeners supply Parmigiano-Reggiano to 22 percent of traditional retailers. The standard commercial dealings of the small traditional retailer are decidedly more complex even in numerical terms. Indeed, each small retailer has a contract with an average number of 1.94 suppler cheese dairies, 1.36 ripeners, 1.5 specialist wholesalers, and 1.3 non-specialised wholesalers. The amount of Parmigiano-Reggiano bought by a traditional retailer could easily be provided by the production of even one small cheese dairy. This networking of contracting relationships, therefore, indicates that the small retailer still represents a privileged point of contact between a varied supply and a demand that is equally attentive to differences of price and quality.

By contrast, the large-scale distribution sector purchases the entire production of the producing cheese dairies in a job lot and their dealings with the ripeners involve bulk quantities of cheese. Their declared objective is to obtain the greatest consistency in terms of quality - a requirement explicitly urged on their suppliers[7]. In traditional retailing this concern is entirely absent,[8] where the dominant criterion behind the decision to buy remains that of quality, a principle which is also consistent with the wide variety of suppliers. This explains why, in the small retailing trade there is room not only for cheese of second grade quality, (in 17 percent of cases) but also cheese of an inferior grade (one percent) and even for unmarked cheeses (two percent). In contrast, the large-scale distribution network only offers more standardised qualities of cheese. In other words, the qualitative range of Parmigiano-Reggiano is reduced when passing from sale by the traditional retailer to modern methods of distribution. The latter's need to standardise the qualitative characteristics of supply leads to the selection of a product that is neither 'excellent' nor too 'inferior' in quality.

This kind of variability in supply is best managed through direct contact between vendor and end consumer. That is why the traditional retailer normally prepares the triangular piece or grated cheese at the counter at the moment of the purchase. In the context of a large supermarket where such personal contact is less frequent and less convenient, two thirds of shops in the large-scale distribution sector offer pre-packaged pieces for sale. Almost half the firms offer the cheese pre-packed in the form of small pieces and sticks ready for eating.

It is clear that where there are such differences in sales 'philosophies', the 'ideal' and 'typical' consumer will be different in these two sectors. The concept of the ideal customer, widely shared by the small retailing trade, is someone who is primarily concerned with the look and quality of the product. The purchase price is the last consideration to affect his or her choice. Supermarket and hypermarket managers though, believe that their customers choose the cheese primarily on the basis of their obsession with price, being much less swayed by the intrinsic qualities of the product. If the two kinds of sale outlet for Parmigiano-Reggiano are oriented towards such different types of customer, the organisation of the two trade sectors will also seek to conform to the guiding customer image. In the long term, the 'virtual' reality of the ideal customer could materialise in flesh and blood form. This is particularly true for the world of large-scale distribution, where sales policies are more likely to find perfect 'copies' over the whole country.

From this overview it is quite clear that the demand for a more standardised Parmigiano-Reggiano cheese will only increase, as a growing share of Parmigiano-Reggiano cheese is sold though super- and hypermarkets. This progressive standardisation of the product is only possible by modifying the production techniques, which carries the risk of a para-industrial banalisation of the product (Antonello 1999). In this way the highest peaks of quality as well as the lowest qualities of Parmigiano-Reggiano cheese will be eliminated in favour of a medium, standard quality. The issue of technological development and the change of production techniques both on the farm and in the cheese dairy will be looked at in more detail in Chapter 8. Here the question of how different actors are collectively looking for solutions that preserve the authenticity of the product and its link with the natural and physical characteristics of the production area will be addressed.

Notes

[1] Quantities of dairy products (cheese, yoghurt, creams etc) have been transformed into milk equivalents, f.e. one kilo fresh cheese = seven kilo of milk equivalent, one kilo Parmigiano-Reggiano 15 kilo of milk etc.

[2] These are products recognised according to EU Regulation 2081/92, where the product quality of the product is linked to the local natural and human factors of the production area and whereof the name is proctected against industrial low cost imitation products

[3] Italian food consumption statistics are divided into geographical areas defined by Nielsen, which are the North East, (including Emilia Romagna), the North West, the Centre, and the South (including both Sicily and Sardinia).

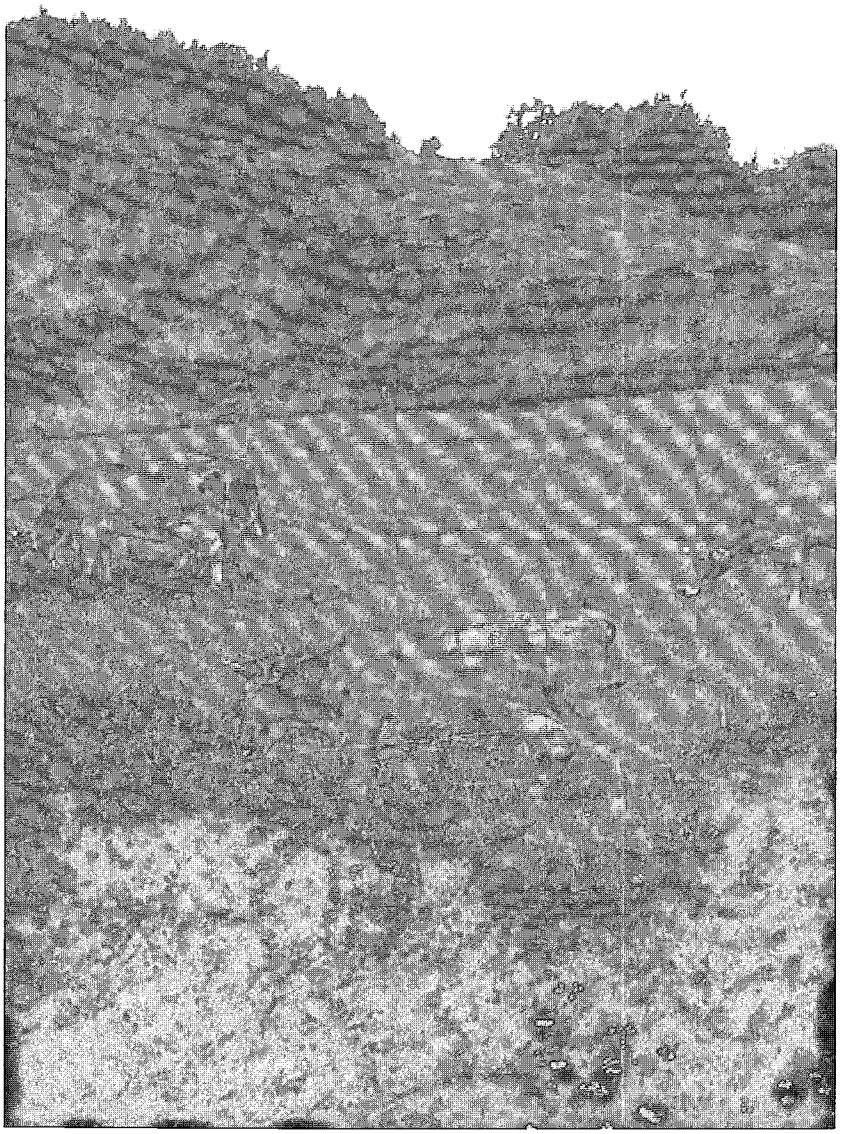
[4] These statistics find substantial confirmation from ISMEA 'Il Consumatore e i Prodotti Tipici Italiani' (the Consumer and Typical Italian Products) Verona 1996. According to this source, providing estimates of purchasing characteristics of Italian households, 39 percent of Parmigiano Reggiano is eaten in the northern regions, 41 percent in central regions and 20 percent in Southern Italy.

[5] According to Databank Parmigiano-Reggiano accounts for 50 percent of total sales of Grana cheese sold in large-scale retail sales outlets, but accounts for 61 percent of sales in the traditional retail sector. ISMEA too, though by a different route, confirms these figures. It estimates the share of sales by the large scale distribution sector at 70 percent for sales of Grana Padano, while 'only' 64 percent for Parmigiano-Reggiano.

[6] The branded trademark of the Consortium, certifying the quality of Parmigiano-Reggiano, is impressed only once onto the whole cheese. When the cheese is pre-packed into small triangular segments, with weights varying between 0.5 to one kilo, since a whole cheese may weigh about 35 kilo, it is a matter of pure chance whether one or two of these segments will bear a part of the markings.

[7] The main criteria used in the selection of suppliers by supermarkets and hypermarkets include the following, listed in order of importance: quality level; maintenance of a consistent quality over time, and reliability with regard to delivery times for the cheese (Ravazzoni/Schianchi, *op. cit.*).

[8] The selection criteria used by small retailers are clearly biased towards the quality of the Parmigiano-Reggiano (85 percent). Price follows (39 percent) and reliability in delivery (16 percent). It is noteworthy that the same sector of small retailers, when deciding on the purchase of Grana Padano, while still using the same selection criteria, concentrate much less on quality (65 percent) and more on price (53 percent) and reliability of the supplier (29 percent). From Ravazzoni/Schianchi, *op. cit.*



7 The Institutional System

7.1 Introduction

All economic actors operating in the Parmigiano-Reggiano production system pursue their own individual economic objectives and the objective of maximising the profit or income of the firm is one of the most important goals. In this sense the economic actors of the Parmigiano-Reggiano system are no different from any other group of actors involved in the production of a certain good. However, the uniqueness and strength of the Parmigiano-Reggiano system cannot be understood without an analysis of the local institutional system. The overall economic performance of the system is not simply the outcome of the sum of the individual strategies followed by its actors. It is highly dependent on the degree to which these actors have worked out collective institutional arrangements. The strong cohesion among actors within the system enables the definition of collective objectives. Of course this process is far from complete and the continuing debate on production regulations is an expression of how individual strategies may still come into conflict within the Parmigiano-Reggiano system.

Nevertheless, the creation of a series of collective agreements to which all actors comply, that emerge from a continuous struggle and debate among the participants explains to some extent the strength and uniqueness of the Parmigiano-Reggiano system. The production regulations themselves have already been examined in Chapter 3 and will be discussed further in Chapter 8, when we begin to analyse the consequences of technological development. In this chapter the specific role of each of the local representative bodies and institutions will be examined and their contribution to the development of the system will be explored. These organisations are the result of collective efforts on the part of economic actors within the system and their attempt to provide common bodies capable of defending the product's reputation and of controlling its quality.

7.2 The *Consorzio* of Parmigiano-Reggiano cheese

The institutional system that encompasses the most important elements of the Parmigiano-Reggiano production is embedded in one single organisation: the Parmigiano-Reggiano *Consorzio*. This oversees legal protection, quality control and product advertising and promotion.

The numerous other organisations that have some connection with Parmigiano-Reggiano operate without any exclusive ties to the *Consorzio*. In other words, while the Parmigiano-Reggiano *Consorzio* is concerned only with Parmigiano-Reggiano cheese and no other product, the complex relational system that has developed around this product is also engaged, to some extent, with other local agricultural products. Therefore, the simplicity of the situation is only apparent. In reality, it is quite difficult to establish the confines of the institutional system associated with Parmigiano-Reggiano, as the peripheral space is full of public and private entities that impinge on the supply chain in a non-systematic way.

Nonetheless, when events related to Parmigiano-Reggiano go beyond the routine and confront exceptional situations, it is likely that one or more of these peripheral subjects might carry out actions that are of primary importance to the product. In addition, if we consider that Parmigiano-Reggiano generates a substantial volume of business, it is somehow also natural that even these more occasional or marginal players become tempted to make noisy 'appearances on the scene'. The most recent example is the National Anti-trust Authority, which no one would ever have dreamed would have become involved in the institutional system of Parmigiano-Reggiano until the question of the legitimacy of the *Consorzio*'s self-determined annual production quotas was raised.

The dairies that produce Parmigiano-Reggiano are members of the *Consorzio* and reinforce the strong historical nucleus of the organisation. Because there are many of them (about 598 in 1999) they are quite effective in preventing any easy 'manipulation' of power within the *Consorzio*. At the same time, the single-product orientation reinforces exclusive loyalty to Parmigiano-Reggiano. To better understand the exceptional centripetal force of this organisation, it is sufficient to consider that it has always managed to maintain a miraculous equilibrium and an equally astonishing autonomy in an area such as Emilia. In this area political divisions are sharp ('whites' and 'reds'[1]) and community rivalries deeply rooted a reflection of the 'basic' culture of the people of this area. The *Consorzio*, which has various names, survived the Second World War and the events that followed up to the present day.

A decision in 1995 to modify the *Consorzio* by law to allow commercial organisations dealing with Parmigiano-Reggiano (maturing firms, wholesalers, distributors) entry hints at an adjustment imposed by external forces with a certain conditioning power rather than at any freely chosen and desired change in 'philosophy'. In fact, the weak point of this 'opening up' process is that, for the first time, *Consorzio* members can be subjects who are a great deal stronger economically than the individual dairies. In addition they may also be interested in products that are different and competitive with Parmigiano-Reggiano (e.g. Grana Padano cheese). Thus, while the *Consorzio*, in its official instances, has put a good face on the situation, the productive base as represented by the dairies has not shown any particular enthusiasm for this decision. At the other hand the entrance of maturing firms in the *Consorzio* enforces its interprofessional character and its political representitiveness.

The Parmigiano-Reggiano *Consorzio* has its central headquarters in Reggio Emilia and branch offices, known as 'sections', in the capitals of each of the provinces belonging to the production district (Parma, Reggio Emilia, Modena, Bologna, and Mantova). The head office is equipped with a laboratory capable of analysing the milk, forage, feeds, and the cheese itself. In this way, through sampling, there is direct control over characteristics, raw materials, and animal feeds making it possible to put an immediate halt to any anomalies in the production process. Such a sanctioning capacity is extremely effective because only the *Consorzio* has the power to stamp the Parmigiano-Reggiano cheeses.[2] Stamping is carried out by the agents of the *Consorzio* after individual cheeses have been tested. Each cheese is repeatedly tapped with a hammer accross its entire surface and only those that 'respond' well to the test – designed to ascertain the compactness of the cheese and an absence of cracks and swelling – are stamped with the official fire quality brand. In cases of doubt, a 'screw needle' is used to check the consistency and aroma of the cheese. The rejected cheeses are stamped with a series of Xs that cover the entire surface to indicate poor quality and to cancel the name Parmigiano-Reggiano on the rind.

The *Consorzio* is financed directly by the associated dairies. In addition to their annual membership fee, they pay an amount proportional to the number of cheeses stamped, just over one percent of the wholesale value of the cheese. These proceeds are easily the *Consorzio* most important income. In addition, the *Consorzio* receives a contribution from the Emilia-Romagna Region to cover the operating costs of its in-house laboratories.

7.2.1 Promotion policy of cheese

The *Consorzio del Formaggio Parmigiano-Reggiano* cheese was founded in 1934. Its objectives were to:

- Defend the denomination of cheese produced in a defined production area and produced in accordance with a code of practice which reflects the traditional way of production.
- Supply the consumer with the necessary authenticity guarantees by means of a fire brand-mark applied to the rind of the cheese.

Within the limits of its institutional objectives, the activity of the *Consorzio* as far as the consumer is concerned is to communicate the genuineness of the product. It also stresses that the product is produced in accordance with tradition and that it has high nutritive and natural values which in themselves confirm its uniqueness.
In 1977, following the strong devaluation of the Italian lire, there was an extraordinary price increase in Parmigiano-Reggiano cheese at the consumer's level and this caused a fall in consumption. After a request to its members, the *Consorzio* had to modify its traditional and rather limited way of communication. It started an advertising campaign that explained that the high price of Parmigiano-Reggiano was justified by its high nutritional and energy value and asserted that
One kilo of cheese contains 16.5 kilo of milk. The message being communicated was based on the slogan 'you only need a little' and showed a small piece of cheese held in two fingers. It was the first time that such information was transmitted in slogan form and the first time the product appeared on national television. This intervention, although much more incisive than previous actions, remained in absolute terms quite limited because its cost did not exceeded two percent of the total turnover of the cheese on the market.

In 1984, expenditure for promotion was doubled and schools and supermarket chains became involved. The objective was to diversify the way people ate Parmigiano-Reggiano cheese. An attempt was made to introduce new ways of using it: fresh cheese eaten in pieces, for example, rather than the traditional image of grating cheese on the pasta meals.
A decisive turning point in the promotion policy of the *Consorzio* occurred in the late 1980s when there was a deep crises in prices caused by overproduction. Members began to advocate more respect for production quotas and more attention to promotion. The budget for promotion was increased substantially. The number of spots on television rose significantly and newspaper and street publicity become more frequent. Sports events were sponsored and specialised marketing agencies like Nielsen and Databank were charged with investigating and analysing

consumer habits in order to develop a strategy for getting the product across to Italian families. The new promotion strategy adopted by the *Consorzio* abandoned the idea of simply passing information to the consumer. It tried to impose the product on them and prevent any loss of market to competitive products such as Grana Padano that had been using massive advertising campaigns for several years. Important communication initiatives included targeting export possibilities through international food fairs.

The language adopted for communication emphasises on the one hand the substantial cultural heritage that characterises Parmigiano-Reggiano. It stresses its exclusive characteristics and, at the same time, updates the message to cater for the 1990s consumer who wants to be better informed and who is well aware of the relationship between the price and quality ratio caused by a reduction in purchasing power.

7.2.2 Cheese production control policy

As a result of the frequent price cycles experienced in the Parmigiano-Reggiano cheese market, a National Law was approved in 1981 giving the *Consorzi* of Grana cheeses the opportunity to programme production in order to control supply and product quality. In accordance with this law, the Minister of Agriculture asks the *Consorzi* each September to estimate the maximum amount of cheese that will be produced in the coming year. The *Consorzio* of Parmigiano-Reggiano cheese has also adopted a programme that involves imposing self-control on supply. This has been discussed and approved by the General Assembly of Members, an organisation consisting of the chairmen of the cheese dairies. A cheese production quota was assigned to each dairy and excess production was to be sanctioned.

When the programmed production is compared with real production over a six-year period, production exceeded the overall production quota in 1990, 1991 and 1995. In 1992, 1993 and 1994 cheese production remained below the imposed quota.

In November 1996 the policy of controlling supply was denounced by the 'National Authority on Competition and Markets' (Anti-Trust Authority). It accused the *Consorzi* of 'mutual agreements to reduce competition'.

Table 7.1 Production of Parmigiano-Reggiano cheese and the production quota

	Parmigiano-Reggiano		Percentual
	Quota	Production	Variations
1990	962.80	1.094.270	+6,3
1991	1.025.204	1.062.640	+3,6
1992	1.025.204	996.228	-0,9
1993	1.025.204	920.300	-10,3
1994	995.000	927.080	-6,9
1995	995.000	985.200	+2,6

Source: *Consorzio* Parmigiano-Reggiano

The *Consorzio* of Parmigiano-Reggiano cheese replied to this accusation by asserting that supply control was intended to maintain the quality of the cheese. The final verdict was that the *Consorzi* had to abandon their supply control policy.

7.2.3 Cheese quality classification

A Factors in the Quality Assessment Process

The factors considered for each individual Parmigiano Reggiano cheese during the classification process can be summarised as follows:

- *Age* The month and year of production can be established from the figures stencilled on the sides of the cheese and contained in the branded trademark.
- *Degree of maturation* This is in relation to its age, but it can also be deduced from the flavour, smell and the consistency of the cheese body.
- *Aroma* produced by tasting and smelling the body of the cheese. In combination these are characteristic and unmistakable.
- *Structure* The structure of the cheese body must be radial and converge towards the centre of the cheese. When cut with a knife the cheese should open up along a straight line and show slight cavities.
- *Colour* The colour of the cheese (hay-coloured) must be uniform not only for the cheese itself, but also for the other cheeses making up the consignment.
- *Consistency* The cheese body must be soft, showing white grains derived from the transformation of the substances used. Consistency is primarily related to the degree of maturation and the fat level.
- *Rind* This should be soft and waxy and an old gold yellow in colour. It should have a width of about five millimetres.
- *Cheese size* The weight of each individual cheese should be between 30 to 35 kilogrammes. Its vertical sides should be between 23 and 25 centimetres high and 35 and 45 centimetres in diameter.

B Techniques used for quality assessment
The cheese is inspected by 'experts' of the *Consorzio* who confirm the absence of defects and anomalous smells by the appearance and odour of the cheese. These experts use only a few, simple tools in their inspection. These include the small percussive hammer, the tapped needle, and the cheese iron or sampler. The experts attach particular importance to the 'percussive' or 'beating' qualities of the cheese in the quality assessment process.

The percussive operation consists of holding the cheese in an upright position while hitting it on its vertical sides with the small hammer. The noise produced should be dry, full and unchanging whatever point of the cheese is being tested. This indicates that the body of the cheese is compact. The operation described above requires considerable experience and the operator must have a good ear and be able to detect variations in the noise produced. This is important in making a correct assessment of the qualities and defects of the cheese being examined.
After the analysis of the cheese's percussive qualities have been made, a sample is taking from the cheese using a 'tapped needle' (needle sampling). The needle is driven into the vertical surface of the cheese two or more time in the case of an unripened cheese and into the centre of the cheese if it is matured. This method allows a small amount of the cheese body to be extracted in order to test it for smell, taste, buttery consistency and, if it is a matured cheese, the flavour and state of maturation has also to be evaluated.

In 'doubtful' cases a third test is made using a cheese iron. The iron makes it possible to extract a much larger plug of rind and cheese body. This facilitates the final qualitative judgement. The iron is not used very much because the 'sampled' cheese will always bear the marks of the test.

'Splitting' two or three cheeses taken at random from a particular consignment is a technique reserved for very large consignments. The cheese is 'split' into two parts so the entire inside can be examined.

C Product classification
Parmigiano-Reggiano cheese is classified on the basis of its age and of intrinsic product characteristics.
Age in Parmigiano Reggiano cheese terms is categorised as follows:
- *New*: Cheese that is 12 to 14 months old;
- *Old*: Cheese that is 18 to 24 months old.
- *Extra old*: Cheese that is at least two summers or between 24 and 36 months old.

Parmigiano Reggiano cheese is also classified using the following terminology:
Select When the cheese does not present any defect either externally or internally (it has passed the hammer and needle tests, and its size, body structure and flavour are good). As the word indicates, its characteristics are such that it is considered to be of superior quality.

Zero While exhibiting the general features associated with a 'Select' classification, the cheese has some small superficial fissures, slightly burred edges and some negligible corrections visible in an otherwise well-formed rind. Either no mark is made on the cheese or a zero ('0) can be inscribed.

One Slight but clearly visible corrections, small pockmarks of three to four centimetres in diameter, holes that are slightly abnormal and it responds more 'slowly' to the hammer. This means it has a soft or loose body that gives out a somewhat hollow sound when hit by the hammer. The cheese is marked with one ('I'). If the cheese has a sheep cheese flavour, the cheeses are marked with a plus sign. If the defect is a significant one, the cheese is regarded as waste production.

Two Also known as 'Middling'. The cheese suffers from noticeable cupping, holes are too wide, slight peeling, large pock marks, wide corrections on the surface, substantial cracking which is still possible to remedy with cauterising, even though the cheese as a whole is somewhat deformed. The cheese is also referred to as a 'second level' cheese. It is marked with the Roman two ('II'). The consortium's quality brand mark is not impressed on this type of cheese. The name of origin impressed on the rind at the beginning of production is cancelled by a series of 'Xs'.

Three This designation is reserved for cheeses that display swelling, flaking, irremediable cracking, bad smell or taste, are excessively thin, have corrections and pieces that are detached from the deformed body. It is classified as 'scartone' (waste). A zero with a line through it is marked on the cheese or a Roman three (III) is impressed. The quality brand mark is not impressed on this kind of cheese and the name of origin impressed on the rind is also cancelled with a series of 'Xs'.
Dealers use the following terminology to describe the product at the contractual stage.

- Select 0-1.
- Select merchandisable quality'.

There are also other expressions that are used when a consignment of cheese is being described. This makes it possible to give a more precise description of the product. Some examples of these expressions are:

- With reference to size: big, little, thinnish, has little head, tendency to flake, June and July waste production.
- Referring to the results of the odour test with the needle: good, acid, hay-like, cow-shed like.
- Consistency: great, little, pasty.
- Body: yellow, white, coloured.

A further 'dealer' classification is made on the bases of the season in which the cheese was produced:

- Prime production cheese: production between January and April.
- Spring or August cheese: production between May and August.
- Late production cheese: production between September and December.

From a dealer's point of view, a consignment of cheese is considered excellent if the 0-1 cheeses do not exceed five percent. It is considered good if 0-1 cheese does not exceed 10 percent. It is considered mediocre if their percentage is between 15 and 20 percent

7.3 The Regional administration of Emilia-Romagna Region

Among the public bodies involved in Parmigiano-Reggiano cheese production, the Emilia-Romagna Region plays a primary role. This is the region in which the majority of Parmigiano-Reggiano production takes place although some also takes place in a small area of Mantova Province in the Lombardy Region. In addition to financing part of the *Consorzio*'s laboratory activity, the Emilia-Romagna Region manages a telematic service over the entire regional territory. This is known as Agri-Net and it collects, processes, and transmits data on the biochemical composition of the cow's milk produced on the farms. The sites of the network are located at the various offices of the Provincial Cow Breeders Association (APA), where data from individual farms is passed on to be collected and processed at private laboratories located throughout the production zone. The APA, in turn, transmits this information to the dairies that receive the milk and to the *Consorzio*. The technical management of the network service and the statistical data processing (territorial and trend analyses) are entrusted to the Research Centre for Animal Production (CPRA) of Reggio Emilia. Agri-Net ensures that the quality of milk destined for Parmigiano-Reggiano cheese is kept under constant observation. It not only responds to the need for continual control and planning of the supply chain, but it also permits a greater diffusion of the system of

paying for milk by quality. In fact, in the dairies that use this method, the price paid to milk suppliers is based on the individual values determined by laboratory analyses. These are the same values that are transmitted to the *Consorzio* and to CRPA. Agri-Net is the diagnostic tool on which the technical assistance service relating to animal nutrition, milking systems, disease prevention, etc. supplied by the APA to the individual farms and the service supplied to dairies at the request of private laboratory technicians are based. The data are collected once a fortnight.

7.3.1 Milk quality payments schemes

In Parmigiano-Reggiano cheese dairies, the prices farmers are paid for their milk varies considerably. In fact, prices are set using different methods according to the type of management system operating in the cheese dairy concerned.

- In co-operative cheese dairies managed directly by the milk producers, payment is made on the basis of the commercial results achieved by the co-operative.
- In private cheese dairies run by a single entrepreneur, payment for milk is made according to a market reference price. This is normally agreed upon at the beginning of the year. This reference price is the result of negotiations between the milk producer's organisations and entrepreneurs from the private cheese dairies.

For both structures the method for calculating payment level has always depended both on the quantity of the milk delivered and on its qualitative characteristics.
Before a milk quality payment system was introduced, the effective application of a system where milk price levels are set on the basis of qualitative characteristics has always encountered resistance. Farmers are reluctant to accept the methods put forward to assess milk quality.

Up to about 1975, milk quality was assessed on the basis of fat and casein content. Subsequently, in an attempt to improve the assessment procedure, factors relating to health and hygiene were also taken into account as well as purely cheese-making qualities. In 1984, the *Consorzio* of Parmigiano-Reggiano cheese produced an initial checklist for milk quality evaluation. However, as a result of the large number of errors that occurred when it was used in the field, this check-list was modified by the *Consorzio* in 1991.

The new checklist measures milk health, content and hygiene properties using the same points system. The differentiation made lies in the greater

number of points awarded to proteinaceous substances (casein) and fat – casein in particular – giving it a determining role in the final number of points awarded.

Table 7.2 Table for the technical and economic evaluation of milk

Analysis	Values	Points Evening milk	Morning milk
Acidity	3.00 – 3.90	1	1
	< 3.00 or >3.90	-2	-2
Cell count	<300,000	3	3
	301,000-500,000	0	0
	501,000-750,000	-4	-4
	751,000-1,000,000	-8	-8
	>1,000,000	-12	-12
Lactodymamographic Test	A-B-C		5
	D – E		0
	F – DD		-6
	FF		-9
Bacterial coliform count	< 10,000		3
	10,000-50,000		0
	>50,000		-3
Total bacterial count	Normal N	3	
	High EL	0	
	Very high	-3	
Clostridium test	Negative	0	0
	Positive	-3	-3
Fat (%weight/weight)	each 0.1 more	0.3	0.3
	3.2	0	0
	each 0.1 less	-0.3	-0.3
Casein (% weight/weight)	each 0.1 more	2.5	2.5
	2.1	0	0
	each 0.1 less	-2.5	-2.5

Source: *Consorzio* Parmigiano-Reggiano

Note: Tests for the presence of inhibitors should be effected on all samples. Source: *Consorzio* Parmigiano-Reggiano. Values giving rise to the award of zero points are not to be understood as 'excess values' or 'normal threshold levels'. They have been set with the aim of finding the correct balance for points awarded for casein within the total score of the technical evaluation.

The characteristics of the milk are surveyed by making a fortnightly analyses of samples taken alternately in the morning and evening. A milk quality score is awarded to each producer on the bases on the results of this analysis. This score is then used when the accounts are made up to determine price. The score influences the price calculation. The amount

paid to individual farmers can be established using three different methods:

- Method 1 calculates the price of the milk in a manner that is directly proportional to the score achieved by each individual farmer.
- Method 2 provides for a predetermined adjustment between the maximum and minimum score.
- Method 3 involves part of the price being fixed for all farmers and a proportion that varies in direct proportion to the score achieved.

The General Assembly of the associated members of the cheese dairy determines which method is used. They base their decision on their assessment of the benefits and defects of each method. We can identify the following as being the main positive and negative features of each method:

First method

Payment for milk calculated in a manner that is directly proportional to the score achieved can be too punitive when applied to some farmers, especially those small producers who receive only a small return because they have a small dairy herd.

The application of the method that is directly proportional to the quality score could lead, in the first years of its application, to strong resistance by those producers most penalised by it. This in turn could lead to negative reactions not only to the method of evaluation, but also to the very concept of paying for milk according to its quality. Hence, the proportional method, while being objectively the most valid, is best applied in cheese dairies where there is not much variation between farmers' milk quality scores. It is hoped that this aim will be achieved in the coming years making it possible to establish payment according to quality over a larger area.

Second method

In the model proposed by the *Consorzio*, the maximum deviation between the minimum and maximum scores is set at ITL10,000 per 100 kilo of milk. This is excessively generous to 'bad' producers and unduly punitive to those producers who, while achieving scores that deviate slightly from the average score, still find themselves below it. Pre-fixing the deviation between the minimum and maximum scores means that the price-measuring scale is at variance with the actual differences in those same scores. This leads to a system which penalises small deviations and which is over-generous to large ones.

Third method

The third method provides for a fixed quota that is the same for all producers (for example, ITL 55,000 per 100 kilo of milk). The remainder of the price calculation is directly proportional to the quality score obtained. This technique seeks to include all the benefits of the first method, while softening those more drastic aspects whose impact on prices is particularly evident during the first years of application. Another reason for using this method lies in the concept of mutual aid - a principle that has always been taken into account in co-operative dairies. This third method guarantees a 'minimum' return on costs incurred.

It should also be borne in mind that the proportional size of the fixed and variable quotas may change from one cheese dairy to another. They can be adjusted to the individual circumstances of each case and the strategies adopted by each dairy. Thus there is little doubt that where the milk is very homogeneous in quality, the fixed quota may represent only a small proportion of the whole. However, where there are wide differences, the fixed quota may represent a high proportion of the end price.

In cheese dairies run by private entrepreneurs, a fourth method is used. Here the supply contract specifies an average score and premiums are added to, or penalties deducted from the contractual milk price depending on whether the milk has scored above or below the average figure.

Table 7.3 Is milk being paid according to quality? (n=115)

	Integrated %	Small %	Medium %	Large %	Total %
No	38.5	45.8	25.5	5.6	29.6
Yes	61.5	54.2	74.5	94.4	70.4

Source : CRPA

Survey data[3] show that 70 percent of cheese dairies actually pay for milk according to quality and that the large dairies in particular apply this system. The smaller co-operatives are less likely to award or penalise producers according to the quality of the milk they deliver. Probably one of the reasons for this is the high cost of analysing the milk that some small dairies may find prohibitive.

Table 7.4 Is casein being paid sufficiently with the system adopted by this cheese dairy?(n=72)

	Integrated %	Small %	Medium %	Large %	Total %
No	18.2	7.7	29.7	36.4	25.0
Yes	81.8	92.3	70.3	63.6	75.0

Source : CRPA

Whether the system adopted pays more or less the casein content of the milk is a second question. Although the majority of respondents believe that an adequate price is paid for casein among the chairmen of the larger dairies, a consistent minority thinks that these payments are not enough. In other words the system awards more to hygienic characteristics than to fat and casein content. This can be attributed to the fact that the powerful, large, leading intensive farms will have high milk yields per cow with moderate casein contents but their hygiene quality will be high because of the sophisticated milking technology they use. They may opt for a system that puts the accent on the hygienic characteristics of the milk.

Form this brief overview of the milk quality payment system operating in the cheese dairies, it is clear that the system adopted is the result of negotiations among the members of the cheese dairies and that this is strongly influenced by the *Consorzio* and the Emilia-Romagna Region. The *Consorzio* attempts to make the payment system uniform by means of a point system. This leaves the dairies a degree of freedom to apply the system according to their own specific requirements and the power relationships that affect them. The Emilia-Romagna Region tries to stimulate the adoption of the system. It grants subsidies to those dairies that have introduced the point system in an attempt to realise its objective of raising the overall quality of the milk used in making Parmigiano-Reggiano cheese.

7.4 The EU policy for Parmigiano-Reggiano cheese

A special paragraph has to be devoted to this particular subject because, without an awareness of EU policy, it is not possible to understand either the Italian dairy milk market or the market of PR cheese.

In 1968, EC regulation 806 brought into being a common market for dairy products. Specific measures were prescribed for the two Italian hard cheeses: Grana Padano and Parmigiano-Reggiano. Article 5 stated that, each year, the EC would fix:

a An intervention price for butter.
b An intervention price for skimmed milk powder.
c An intervention price for Grana Padano and Parmigiano-Reggiano.

The intervention prices for skimmed milk powder and the two hard cheeses were fixed at such a level that the milk producers in the Grana Padano and Parmigiano-Reggiano region will have milk price guarantees similar to those available to all EC dairy farmers. The EC has included these two products in its intervention policy taking into consideration the specific situation of the Italian dairy market - where little butter or skimmed milk powder is produced - in order to give Italian milk producers similar protection.

Article 8 of Regulation 806/68 makes provision for a financial contribution to be made for the private stocking of:
a Grana Padano cheese of at least 12 months age.
b Parmigiano-Reggiano cheese of at least 18 months age.

The EC policy for the two cheeses also covers subsidies for exports outside the European Union. The details of intervention policy and the subsidies for private stocking are defined in Regulation 1107/68. An interesting aspect of this regulation is the fact that the EC only allows firms that satisfy the requirements of the designation of origin to intervene in the market or receive subsidies for maturing the cheese after 18 months. For Parmigiano-Reggiano cheese the maximum length of the subsidy period was 12 months.

After 1968, there were very few interventions in the market for Parmigiano-reggiano and Grana Padano. There were a few cases where the prices of the two Grana cheeses fell below the intervention prices. The Italian off-farm milk price has always been higher than in all other EU member states because the Italian milk market is a deficit market, about 30 percent of own consumption is covered by imports and a very large share of Italian milk production is processed into cheeses giving a high added value to the cheese

The last significant intervention was in 1992/93 when prices dropped because there was more production than the existing demand could absorb. In 1994 the intervention prices have been abolished.

The financial contributions granted for maturing the cheese are particularly important. Up to 1994, amounts were fixed at ECU/100 kg per month of maturing and they varied according to the green lire's rate

of exchange. In 1994, Regulation 2659/94 brought changes into the way private stocking was subsidised:

1 The minimum age has been lowered to 15 months.
2 The maximum period of subsidies has been fixed at 255 days (8.5 months).
3 A minimum period of 60 days was introduced.

The subsidies per 100 kg/month have been fixed in three separate amounts:

1 ECU 100 per ton as a contribution to fixed costs.
2 ECU 0.35 per ton per day for stocking costs.
3 ECU 1.20 per ton per day for financial costs.

Firms responsible for maturing Parmigiano-Reggiano cheese make a request for subsidy to the AIMA, the Italian national agency for intervention in agricultural markets. This agency controls procedures and grants subsidies for minimum quantities of two tons cheese in the age range 15 months to 23.5 months.
This policy has to be seen as a mixture of measures that are complementary to the subsidies for the private stocking of butter and skimmed milk powder granted by the EU in the other EU Member States.

7.5 The Local Health Authorities

Emilia-Romagna Region is also involved in the Parmigiano-Reggiano system through normal local authority channels and institutions. An example is the Local Health Authourity's (ASL) control and supervision of farms through its veterinary services. At the administrative and bureaucratic level there are also the activities of the Provincial Agricultural Service, which has offices in each of the provinces in the Emilia-Romagna Region.

If we consider that in the Parmigiano-Reggiano production area, approximately 90 percent of cow's milk is used to make cheese, it is easy to see why the public services in this area are clearly oriented toward the Parmigiano-Reggiano supply chain. In this area it is only pig breeding that is able to mobilises public resources to the same degree as the breeding of dairy cattle. It should be pointed out that these forms of regional involvement do not compromise the autonomy of the Parmigiano-Reggiano supply chain. Health department controls and supervision are concerned with ensuring livestock breeding and milk production standards in general and do not pay specific attention to Parmigiano-Reggiano and the structures of its production.

The other interface between the Region and the Parmigiano-Reggiano supply chain is in the area of legislation. In particular in relation to territorial planning (characteristics of livestock buildings, zoning of agricultural areas, rural road regulations) and the environmental impact of livestock breeding facilities and dairies (processing wastes, disposal of animal wastes). These aspects are important in a territory where the centuries-old combination of dairy cattle and pig breeding have been carried out in a very intensive way and present considerable problems in terms of environmental compatibility. In this respect, legislation in Emilia-Romagna is concerned with putting a brake on the indiscriminate growth of livestock farms. It also creates an effective barrier within the Parmigiano-Reggiano supply chain to the spread of businesses (farms or dairies) that do not respect the standards established by the regulations. At the same time, however, these measures place block the extent to which the system can expand.

7.6 The Mountain Communities

Operating in the mountainous part of the Parmigiano-Reggiano production area, which in this case involves only Emilia, are the 'Comunità Montane'[4], public bodies that act as an association of local authorities and have planning functions. Recent history documents a number of attempts by these associations to give the Parmigiano-Reggiano produced within their area an additional brand mark. However, because of the fragmentation of these initiatives and to the lack of any continuity, these objectives have been shelved. It is unlikely that such proposals will find any support outside the mountain area, if we consider that the Parmigiano-Reggiano produced in these areas is just over 20 percent of the total. Until now the impact of the Comunità Montane on the Parmigiano-Reggiano supply chain has been limited and has fallen short of its actual potential for influence.

7.7 The organisation of the co-operatives

Another institutional player occupying an important position in the Parmigiano-Reggiano supply chain is the agricultural co-operative. The vast majority of dairies are organised in the form of farmer co-operatives. These co-operatives belong to central representative units organised according to province and political 'colour' (Lega delle Cooperative for the 'red' dairies, Unione delle Cooperative for the 'white' ones). The co-operative associations represented in the Parmigiano-Reggiano supply

chain exercise two types of influence. The first is at the level of the dairies themselves and take the form of activities that provide orientation and direction although they do not have binding power. The most recent example is the push toward a 'rationalisation' of the production system. There has been much ado about processing costs during recent years and measures such as dairy mergers and increases of scale have been advocated. The second influence is at the *Consorzio* level. These co-operative associations have considerable influence over the associated dairies and, by means of 'cartel' agreements, have the power to decide on consortium management positions including the post of president. This power is even greater than it appears given the fact that non-co-operative factories without their own representative organisations cannot come to agreements about alternative candidates very easily. Therefore, the power of the co-operative associations is considerable especially when we remember how local rivalries permeate the entire Parmigiano-Reggiano region. The co-operative associations, particularly in recent times, act as a 'check' on such rivalries and organise the 'game' according to a complex system of balances between territory and political alignment to which they alone have the key. This power is demonstrated not only in the form of consortium management selection but also in the capacity to orient the consortium's operations and strategic decisions. While it is true that the Parmigiano-Reggiano *Consorzio* cannot be seen as purely and simply a tool of the co-operative associations, it is very unlikely that the *Consorzio* could develop a strategy of its own in opposition to a position sustained by the co-operative associations.

7.8 The farmers' unions

In addition to its representative function and its explicit and implicit power, the union also supervises the bureaucratic, economic, and fiscal aspects of the associated dairies. This is a job that is often carried out by private accounts but in this case the union is paid for taking on the task.

The position of the farmer's unions and the farm-workers general representative organisations is not as important as the position of the co-operative associations. Local union organisations are branches of national confederations (Coldiretti, Confederazione Italiana Agricoltori, Confagricoltura), and are organised along territorial lines (provinces). They are differentiated according to political alignment. In the years immediately following the Second World War, the weight of the unions on the Parmigiano-Reggiano supply chain was much greater than it is today. During the period of post-war reconstruction, it was the unions that organised farmers into politically homogeneous groups. This gave

rise to a host of dairies, one politically opposed to the other. Due to the gradual weakening of the 'red-white' antagonism, the drastic fall in agricultural activity and the development of more pragmatic agricultural 'philosophies' oriented toward economic action and its 'rules' rather than idealistic and 'clannish' views, the steering power of the so-called agricultural unions gradually started to diminished. Over time, extension services to farms, traditionally the strong point of the unions, also lost their original global and generic connotations. They became an increasingly specialised activity oriented toward specific segments of local agriculture. At the same time equally specialised agencies began to spring up. These were almost always autonomous as far as the agricultural unions were concerned and were equipped for more limited functions. Nonetheless they supplied a highly professional consultancy which responded better to farmers' needs.

Recently the prestige of the agricultural unions has come under attack – and not only in the Parmigiano-Reggiano territory – in the matter of milk quotas. Having long oscillated between 'loyalist' positions and bland dissent, the unions were completely overtaken by a spontaneous movement of farmers who decided to adopt a strategy of loud protest. The unions, branded as 'traitors', found themselves at the receiving end of farmer discontent.

However, it would be naive to believe that these organisations will actually lose influence in the Parmigiano-Reggiano supply chain because, like the co-operative associations, their matrix remains political. In Emilia, exchanges – of people, projects, strategies – along political 'corridors' of the same 'colour' are quite a common phenomenon. For this reason, agricultural union men 'come and go' both within the co-operative movement and at the local and provincial political level. These 'exchanges' form an extremely effective instrument of communication and influence throughout the Parmigiano-Reggiano supply chain, even when the phenomenon is less visible and recognisable 'to the naked eye'. Currently, the institutional responsibilities of the agricultural unions – other than representation – include providing 'basic' technical assistance, professional training, company accounting, and bureaucratic, economic, and fiscal assistance to union members.

7.9 The cattle breeder's organisations and extension services

The extension service provided by the APAs (Provincial Farmers Associations) has a much more decisive influence. These organisations are

local units of the Associazione Italiana Allevatori (Italian Farmers Association) which bring together all types of livestock breeders involved in animal production activity on a voluntary basis. The APA is partly funded by public money and partly by its members, who pay an annual fee in proportion to the number of cows involved in the controls. By law, the APA, which is not politically aligned, has the task of controlling dairy cow productivity through on-site surveys. It processes the data it collects and publishes it in special bulletins. Based on this information, the APA supplies technical assistance especially on subjects such as dairy cow nutrition to associated farmers. In Emilia, the APAs also function as sites for the Agri-Net telematic network. This provides a connection to the laboratories where quality analyses of the milk produced on the farms is carried out. In addition, the APA offers a specialised service that involves carrying out periodic functional checks on the milking systems of associated farms. In the Parmigiano-Reggiano supply chain, the extension service provided by the APA is only second in importance to that supplied by private veterinarians as far as animal health and milk cow insemination is concerned.

The veterinarian is the most important reference point for individual farmers and is a professional figure that plays an indispensable role in the Parmigiano-Reggiano supply chain. We refer here to private, self-employed veterinarians who have full professional autonomy, are independent of any association[5] and who are financed by the fees they earn from the work they do for farmers. The veterinarian's classic area of competence is that of animal health, but with time the farms' genetic programming has also passed entirely into the hands of these professionals. Before 1970, veterinarians would only make incidental visits to the farms in the Parmigiano-Reggiano supply chain. Today, however, their presence is considered to be part of the normal routine. This is due to the almost total diffusion of artificial insemination and the results of genetic planning which has brought about a rapid qualitative transformation of the bovine patrimony which is now capable of new productive performance although at the same time it has become much more 'vulnerable'. These private veterinarians should not be confused with those from the Local Health Authority, whose responsibilities are limited to disease prevention and controlling the overall state of animal health on individual farms in the collective interest.

Animal nutrition specialists are also gaining increasing importance in the farms of the Parmigiano-Reggiano supply chain. The growing use of compound feeds and vitamin supplements to meet the nutritional needs of the dairy herd has resulted in a crisis in farmers' traditional knowledge

as far as the complex balances between the cows' dietary needs, state of health, and performance are concerned. At the same time, the animals' improved performance has increased farmer' 'dependence' on nutritional specialists. Despite the fact that this work is also undertaken by the APA – whose role does not involve any commercial interests – the feed industry, in order to consolidate and strengthen its position among the clientele, has set up a vast network of nutritional specialists. These cover the whole Parmigiano-Reggiano production area and maintain direct contact with farmers. Nutritional specialists, employed by the feed industry, are gaining the trust of farmers. At first sight their service seems to be free of charge but in fact the cost of their services is incorporated into the price of the feed. Self-employed nutritional specialists are not common in the area.

7.10 The scientific research centres and agricultural schools

Finally, we should mention the role of education and scientific research in the Parmigiano-Reggiano institutional system. Strictly speaking, there are no institutions in the Parmigiano-Reggiano area that are directly involved in providing scientific and vocational training for those working in this field. For many centuries the cheese makers who occupy a strategic position in the system have been trained through the medium of oral communication. Empirical knowledge has almost always been transmitted through primary socialisation channels, in this case from father to son. Even though this process has weakened with time, the fact remains that today processing milk into Parmigiano-Reggiano cheese requires artisan type skills, constructed and perfected inside the dairies rather than in schools and scientific laboratories.

This does not mean, however, that schools, research institutes, and universities in the Parmigiano-Reggiano area have not contributed to the diffusion of a scientific culture in relation the production process. This culture, in fact, has gradually become stronger throughout the system and has affected the professional profile of farmers and dairy workers. Nevertheless, the school-research-university system is most evident in the area of services related to the system.

There are universities in Parma, Reggio Emilia (a branch of the University of Bologna), Modena, and Bologna. The University of Parma has a Veterinary Medicine Department, the strategic role of which is explained by the importance of veterinarians throughout the Parmigiano-Reggiano area. Parma also has a Food Production Technology Department, and the Department of Economics organises specific courses in agricultural economy. Reggio Emilia offers a degree course in Animal Production

Science, organised by the Agricultural Science Department of the University of Bologna.

The new generation of executive-level personnel working in the farmer's unions, the co-operative associations, and the services connected with the Parmigiano-Reggiano supply chain have all had a university education in one of these fields. It is mainly these graduates who bring a coherent and shared scientific culture into the Parmigiano-Reggiano supply chain. Moving away from the top-level posts in the service sector to those at the production process level we find that the elements of this culture within the extension service and vocational training are more discontinuous and occasional.

The pre-university agricultural schools (State Technical and Vocational Agriculture Institutes), that issue agronomist's diplomas, are located throughout the Parmigiano-Reggiano area. Like the universities, this type of school does not emphasis Parmigiano-Reggiano specifically in its curriculum. Because they are organised according to a national curriculum, the agricultural institutes give the same courses that are given in this type of school throughout Italy. It should be noted, however, that in the Parmigiano-Reggiano production area, there is a particular interest in subjects specifically related to dairying and cheese-making because of the strong roots these institutes have in local reality. It is not uncommon, in fact, for these institutes to be equipped with stables, small Parmigiano-Reggiano dairies, and analytical laboratories, which act as demonstration supports for teaching activity. Established in the second half of the nineteenth century, immediately after the formation of the Kingdom of Italy, these agricultural schools have long played a fundamental role in the instruction of technicians working in the Parmigiano-Reggiano supply chain, and they have also conducted scientific research on particular aspects of the production process. To give just one example, the whey starter technique applied to Parmigiano-Reggiano production was first theorised and developed experimentally at the Zootechnical and Dairy School in Reggio Emilia, which is part of the Zanelli Agricultural Institute.

The rapid growth in university instruction that began in the 1970s thus only partially shifted the role and function of the agricultural institute from that of completely self-sufficient training facility to a point of transition toward university studies.

The Mantova Milk and Dairy Production Institute does not have a teaching function but confines itself to research and experimentation. This institute operates under the auspices of the Lombardy Region and, as such, is a public body.

The activities of the Institute include experimentation on specific techniques for processing cow's milk into 'Grana' type cheese, in this case mostly for Grana Padano but also to some extent for Parmigiano-Reggiano. The Institute operates a fully equipped experimental dairy and analytical laboratory. Its geographical location, on the divide between these two principal Italian cheeses, constitutes an element of exceptional interest for the Parmigiano-Reggiano supply chain. It is in Mantova that processing technique experiments are conducted that are on the 'frontier' of the discipline and often beyond. Cold-processing technology is only one of the fields of application of this type of research. The entire Parmigiano-Reggiano supply chain relies on the Institute in Mantova to investigate both the possibilities and limits of technological developments applicable to a production system that is strongly conditioned by cast-iron discipline.

The Reggio Emilia Research Centre for Animal Production (CRPA) was founded in 1971 with the objective of co-ordinating research funds in the Emilia-Romagna region. It plays a significant role in the technical research associated with the introduction and screening of new technologies. Although a considerable part of the research is carried out by the local university institute and co-ordinated by CRPA, the autonomous research activities of this Centre have expanded year by year. In this respect reference should be made to activities that centre on the environmental impact of animal husbandry; research into the effects of artificial hay drying on the quality of milk and Parmigiano-Reggiano cheese; research on innovations in livestock buildings, equipment and machinery; software development, and the economics of animal production.

This is the institutional system that impinges on the Parmigiano-Reggiano supply chain. Apart from the *Consorzio*, all other public and private players have functions that go beyond Parmigiano-Reggiano cheese. This is one of the reasons why there is not a particularly high level of integration among players. Each one maintains its own autonomy and the objectives pursued are not always convergent. Indeed, examples of more or less manifest controversy do occur, but never result in real conflict because the field of competence of each of these organisations is quite well-defined and limited. This lack of synergy does not cause particular damage to the Parmigiano-Reggiano supply chain. Indeed, in moments of crisis, when product-oriented thinking is subject to strong pressure by market-orientation involving all players, it is precisely the lack of strategies common to the entire Parmigiano-Reggiano institutional system that leaves the 'substance of things' unchanged. In other words, the 'sovereignty' of Parmigiano-Reggiano and its historical position of superiority above all factions, has often benefited from the lack of grand

'common' projects for its future. It has to be stressed however that during the actual price crisis, started in 1998, this lack of a common marketing strategy starts to have negative effects for the overall economic performance of the system.

Notes

[1] To understand the strength of this culture in Emilia - also in the agricultural sphere - it is sufficient to consider that all the agricultural organisations, both representative and cooperative, define themselves first and foremost in terms of their political alignment. Even the Parmigiano-Reggiano cheese factories belong to this paradigm ('white' vs. 'red', i.e. Catholic vs. Socialist-Communist). This is one of the reasons, if not the principal one, that fostered the extensive development of cheese factories in the territory; i.e. the model in its ideal state (though not at all rare) establishes that in each locality, the 'white' dairy must have a 'red' one as a counterbalancing neighbour. It should be pointed out that this phenomenon reached its peak in the 1950s. Currently, with the simultaneous crisis of the two 'maximum systems' of the Italian political world, this antagonism has weakened considerably, though it has not completely disappeared. Evidence can be found in the extreme difficulty encountered by any attempt at 'rationalising' the territorial distribution of dairies by means of incorporations and mergers: a 'white' farmer, rather than taking his milk to a 'red' dairy one kilometre away, prefers to go 20 more kilometres in order to 'do the right thing'. And the 'reds' do the same.

[2] Now this power has been transferred to new independent organism 'Dipartimento Qualità Parmigiano-Reggiano' following the necessity of the institution of an impartial control body laid down in art.10 of EU Regulation 2081/92.

[3] The overall results of the cheese dairy survey will be presented in chapter 9. Here we just anticipate some results related to the quality payment system

[4] There are a total of seven 'Comunità Montane' in the Parmigiano-Reggiano production area.

[5] Self-employed veterinarians are only required to join their specific professional association, which governs aspects related to professional ethics, including the maximum fees, and oversees the health insurance and social security position of the members.

8 Technological Development

8.1 Introduction

One of the most debated issues among the actors within the Parmigiano-Reggiano district is the evolution of techniques on the farm, in the cheese dairy and in the cheese maturing firms. The updating of Parmigiano-Reggiano production regulations is the result of complex negotiations between farmers, cheese dairies and maturing firms each following different firm strategies[1] This is because the room for manoeuvre as far as technological developments are concerned is closely defined by regulations.

It is very important to stress that technological progress within the Parmigiano-Reggiano system has to follow a specific trajectory and cannot simply adopt innovations developed in other dairy systems. At the same time the system cannot renounce new techniques that reduce production costs because Parmigiano-Reggiano cheese has to remain competitive with other Grana cheeses. The retail price of Parmigiano-Reggiano cheese may not diverge too strongly from Grana Padano and other Grana cheese because demand is highly elastic and sensitive to the price difference between these two cheeses (Messori and Vezzani 1984).

The fundamental issue of the introduction of new production techniques at different stages of the production process (farms, dairies and maturing houses) has to be seen in terms of its impact on the final quality of the cheese. This is the result of a myriad of strongly interrelated and interdependent factors. A change of technology at a certain stage of the value chain creates immediate repercussions at other stages of the production process. This is especially relevant for a product that is being produced according to highly artisan techniques: a vulnerable and fragile equilibrium of local natural and human factors.

The local research institutions in the Parmigiano-Reggiano area, described in the previous chapter, are intensively involved in research programmes

concerned with testing and experimenting with innovations that have either been proposed outside the system or have been endogenously generated. They function to filter out inadequate innovations. In this respect it is interesting to point out that drawing up the annual research programmes that relate to Parmigiano-Reggiano cheese is a negotiated process, where actors (farmers, maturing firms, researchers) pursuing different strategies may come into conflict. Research proposals in the 1980s that were clearly orientated to a drastic reduction in the processing costs of the cheese dairies by industrialising the production process have not been funded by the regional authorities because these were considered to be incompatible with product quality[2]. This example shows that the process of innovation within the Parmigiano-Reggiano system is characterised by continuous debate among actors on the advantages and disadvantages of the new techniques. To a certain extent similar debates take place in a single industry firm where new labour saving production techniques are tested against the final quality of the product. An important difference, however, is that in the Parmigiano-Reggiano system this decision-making process is of interest to more than 7,000 dairy farmers, about 600 cheese dairies and more than 200 maturing firms, each with their own views and opinions which do not always converge.

It is quite clear that because the Parmigiano-Reggiano system is such a complex process, an analysis of technological innovation cannot be treated solely in neo-classical terms. According to standard economic theory, technical progress is characterised by a move of the isoquants curves towards the origin of the axes. Here the cost of information needed to adopt new technologies is considered to be nil and the economic actors can dip out of a stock of constantly and universally available technologies. The point of equilibrium is determined by the maximisation of the profit function under the price vector constraint.

More explanatory power is to be found in the institutional approach to the analysis of the sources of innovation and in the work of those who distinguish between exogenous and endogenous sources of development. Starting with the latter type of approach Van der Ploeg and Saccomandi assert that 'exogenous development is generally characterised by comparatively high levels of transaction and transformation costs, whereas endogenous development involves very low levels of this type of cost' (Van der Ploeg and Saccomandi 1995). In the Parmigiano-Reggiano many new production techniques are the result of the inventions by local machinery firms and local research institutes that are closely related to farm practice and the costs associated with their introduction are relatively low.

Dosi has suggested in analogy with the scientific paradigms in modern philosophy the existence of technological paradigms. A 'technological paradigm can be defined as a pattern for the solution of selected techno-economic problems based on highly selected principles derived from the natural sciences. A technological paradigm channels efforts in certain directions rather than in others, it defines a technological trajectory'. Moreover, 'innovative activities are strongly selective, finalised in rather precise directions, often cumulative activities' (Dosi 1988). The analogy with the process of technological innovation within Marshallian industrial districts is evident when Dosi states that technological bottlenecks and opportunities tend to organise context conditions that are country-specific, region-specific or company specific.

The innovative process is the introduction of subsequent interdependent technologies. In other words, the introduction of a new technology provokes and obliges the introduction of other new techniques that have become necessary as each new technology causes new problems that have to be resolved. According to this point of view one has to speak of technological packages, composed of mutual interdependent production techniques (Benvenuti *et al.* 1988).

Montaigne proposes raising the Dosian concepts of technological paradigm and trajectory to a higher level of aggregation when he suggests analysing the technological process by 'filière d'innovation': an aggregate of firms and organisations, both public and private that participate in the process of technology formation in its technical and economic evaluation and hence in the definition of its trajectory (Montaigne 1994).

In this chapter we will examine the technological development of the Parmigiano-Reggiano system taking into account both the technical and the socio-economic aspects of the problem. The acceptance of the concept of technological paradigm justifies the analysis of the technical content of the innovations in order to understand its economic evolution (Montaigne 1994, p.5). Of course, the technical aspects will be dealt with only to the extent that it is necessary to understand the socio-economic consequences of the choices made as a thorough analysis of the technical aspects would go beyond the scope of this study. First, an analysis will be made of the technical literature stressing the link between final product quality and the local, natural factors that influence milk quality. Next, examples of technological innovations will be analysed, focusing on the key questions that arose when they were being introduced and on the problems of restructuring that they provoked.

8.2 Product quality and its link with local factors

Parmigiano-Reggiano cheese is a hard cheese with a maturing period of at least 18 months. Its fat content is lower than that of many other types of cheeses, since the milk from the evening milking is skimmed off. When the milk is put into the vat the casein-fat ratio is about 1:1. At the end of the maturing period the fat content of the cheese reaches about 36 percent on a dry matter basis. This can be compared to 43 percent for Gruyère, 47 percent for Emmental and 54 percent for Gorgonzola. Protein can account for about 50 percent of dry matter. This is considerable when compared to many other cheeses and makes it particularly suitable for children's diets. The calcium/phosphorus ratio is favourable at about 1.7 and provides a balance with other foodstuffs in a diet that generally contain more phosphorus than calcium. As far as the vitamins are concerned 100 grams of Parmigiano-Reggiano cheese provides 40 percent of the daily Vitamin A and 20 percent of Vitamin B2 intake.

Table 8.1 Composition of some cheeses (per 100 gram dry matter)

	Dry matter	Proteins	Fat	Energy	Calcium	P	Ca /P	Vit. A
	g	%	%	kJ	%	%		mmg
Parmigiano-Reggiano	70.5	51.1	36.3	1,566	1.90	1.10	1.72	290
Grana Padano	69.5	51.2	36.0	1,595	1.85	1.01	1.83	285
Pecorino	67.7	42.1	41.4	1,532	1.71	0.99	1.73	280
Gruyère	68.9	45.1	42.7	1,624	1.65	1.01	1.63	400
Emmental	65.4	43.6	46.8	1,687	1.75	1.07	1.63	425
Fontina	58.9	41.6	45.7	1,436	1.48	0.95	1.56	420
Gorgonzola	57.6	33.7	54.2	1,499	1.06	0.62	1.71	420
Mozzarella	39.9	49.9	40.4	1,017	1.01	0.59	1.71	190

Source: Istituto Nazionale Nutrizione (1998)

As has been illustrated in Chapter 6 the most important substitute for Parmigiano-Reggiano is Grana Padano cheese. This is produced in the regions to the north of the River Po and the techniques used are very similar. There are only very small differences in the composition of these two 'Grana' cheeses. As Grana Padano is matured for a shorter period (up to 15 months) its dry matter content is slightly lower, but in terms of protein and fat Grana Padano is very like Parmigiano-Reggiano.

However, it is the presence of free amino acids that distinguish the two Grana cheeses. Parmigiano-Reggiano is known for its high digestibility because of the strong presence of free amino acids. These amount to 23.2 percent of total proteins, which is higher than in any other cheese and 50 percent higher than Grana Padano. From the nutritional point of view the

free amino acids can be easily absorbed and assimilated without great demands being made on the digestive system (Strata 1997).

Free amino acids are generated during the long ripening process. There is a significant positive correlation between the presence of free amino acids and the age of the cheese (Resmini *et al.* 1988), but their development tends to slow down after about 15 months of ripening. It should be stressed that there is no direct relationship between the total content of free amino acids and the organoleptic characteristics of the cheese. Aroma and flavour are determined by the balance of the various types of amino acids. First, the content of four amino acids varies significantly during advanced ripening: serine and ornitien increase, whereas glutamine and arginine almost disappear. Second, a Parmigiano-Reggiano cheese without defects does not contain gamm-ammino-butyric acid and has a high histidine content. By measuring the variability of the contents of these six amino acids it is possible to distinguish Parmigiano-Reggiano cheese from other similar types of cheese. The typicality of the cheese can be determined in this way.

Table 8.2 Contents of free amino-acids (FAA) in some cheeses

Type of cheese	FAA on 100 g of cheese	FAA on 100 grams of total proteins
Parmigiano-Reggiano	7.71	23.21
Grana Padano	5.02	14.37
Raggianito (Argentina)	3.62	10.72
Gorgonzola	0.83	4.24
Provolone	3.11	11.87
Gruyère	3.64	12.62
Emmental	2.44	7.65

Source: Resmini and Losi (1987)

During the long and slow ripening process Parmigiano-Reggiano cheese, like all cheeses, undergoes a processes of protein degradation (proteolysis) that leads to the formation of peptides, free amino acids and the products of their catabolism. These processes determine the structure, aroma and flavour of the cheese to a large extent (Bertozzi *et al.* 1993). Biochemical research demonstrated that the specific indigenous bacterial flora of the raw milk produced in the Parmigiano-Reggiano district has a decisive influence on the proteolysis process and thus on the final organoleptic quality of the cheese. Each cheese dairy reproduces its own bacterial flora every day by adding the soured whey from the previous day's cheese making to the milk as a natural starter. The bacterial flora is strongly influenced by the cow feeding techniques employed on the dairy farm.

Two factors are fundamental for the organoleptic quality of the cheese. First, the indigenous, bacterial milk flora with its species diversity preserved by means of raw milk processing, is responsible for the colour, taste and flavour of the cheese.
Second, the artisan skills of Parmigiano-Reggiano cheese makers in processing different types of milk whose qualities change from farm to farm and from season to season.

In Chapter 3, we described the geo-pedological and climate conditions prevalent in the Parmigiano-Reggiano production area. The physical conditions of the different sub-areas result in a variety of different forage crop compositions and thus in a considerable difference in the feed rations of cows. Differences in the cow rations are transmitted to the quality of the milk and this in turn affects the quality of the Parmigiano-Reggiano cheese. In this way the natural conditions of the production area directly affect the quality of the cheese and cheese quality clearly varies from sub-area to sub area. The best quality is achieved in the hills and mountains whereas quality tends to be lower in the lower plains near the Po, where the proportion of annual grasses, like green maize, can be considerable.

Of course, the cheese-maker's artisan skills may be able to correct milk quality variations caused by natural conditions. The artisan character of the cheese-makers work lies in his ability to work with raw milk qualities that vary from farm to farm and from season to season without using chemical additives. Variations may occur in the natural creaming capacity of the evening milk, in the time of coagulation and in the consistency of the curd, properties that can be attributed to differences in cow breed and feeding techniques. Each day the cheese-maker decides how much rennet and whey starter should be used and when they should be introduced into each vat of Parmigiano-Reggiano cheese. The final quality of the cheese is therefore determined by a combination of natural and human factors.

Production regulations set boundaries to undesirable developments that may compromise the general quality image of the cheese. Quality variation should not be allowed to become too large because once customers get the idea that Parmigiano-Reggiano cheese is low in quality the whole Parmigiano-Reggiano system will be damaged.

8.3 Technological development on the dairy farm

Within the Parmigiano-Reggiano production cycle the cheese dairies represent the most stable element and the deepest roots of local tradition. They guarantee historical continuity and are the centre of authenticity for the whole system. The production of cow's milk 'upstream' of the dairies has, by contrast, been subject to continual pressure and forced innovation. This has significantly transformed its original character. One of the major stimuli in the direction of change has been the strong competition posed by Grana Padano, particularly as far as production costs are concerned.

Since there are no other restrictions that apply to the technical management of the farms, the rules relating to feed represent the most significant differentiating element and the most vulnerable point of the whole cycle. This is why the Consortium devotes a significant part of its regulatory activities to this aspect of Parmigiano-Reggiano production. From another perspective the problem can be defined as follows: the dairy cattle within the Parmigiano-Reggiano system are identical to those producing milk for Grana Padano. The latter can be fed with silage made primarily from maize. Parmigiano-Reggiano cattle cannot be fed in this way. Given the developments that have taken place in productivity since the 1970s, the ban on silage poses significant problems for Parmigiano-Reggiano dairy farmers. This is not only a result of higher production costs but also a question of the compatibility between continuing unit production growth and the framework imposed by production regulations[3]. It is for this reason that the rules about what should be fed to cows in the Parmigiano-Reggiano dairy system have so often been criticised.

The controversial nature of the feed regulations has meant that the Parmigiano-Reggiano consortium had to issue a new set of regulations in 1989, bringing the composition of feed up to date but without changing the historical ban on the use of silage. The following items were added to the list of banned foodstuffs: fermenting forage crops (including shredded milky-waxy maize) even where dried in the sun; maize or sorghum stalks; maize bracts and cobs, and soya straw. The following by-products are also prohibited in animal feed: the dried by-products of milk processing (whey, butter milk, milk flour); bone meal and fat, urea and derivatives; ammonia salts, protein containing beet concentrates, and any kind of distillers wash or pulp however this may be produced. The rules also impose an explicit ban on the use of antibiotics, hormones and live yeast in animal feed. In addition, no active agent banned by national legislation can be used.

It is important to note that, in 1989, the Consortium – in the illustrative examples included with the rules, assumed that a cow's maximum daily production would not exceed 30 kilo of milk. Less than ten years later, developments in productivity on farms in the forefront of milk production are such that this threshold has been greatly exceeded. Today, there are examples of cows within the Parmigiano-Reggiano district that can produce 40 kilo of milk per day. This means that the rules introduced in 1989 are already out of date as far as these farms are concerned[4]. The Consortium is fully aware of these accelerating trends, and they have produced a new, updated set of regulations that came into force in the year 2000 (see par. 3.1).

8.3.1 Harvesting green forage

The most common feeding technique use by PR dairy farms is that of giving green forage to cattle during the spring and summer months. Small amounts of hay are often added to this diet. In winter, the basic forage is hay derived from alfalfa or permanent meadows.

The land closest to the cowsheds is used for the production of green fodder. Harvesting involves one of two machine combinations. The first system is the more traditional one and is used on smaller farms. There are three consecutive operations: cutting, raking into rows and collecting the crop. Small self-propelled cutters fitted with a cutting bar are used to cut the crop. A small self-propelled hay tedder is used to rake the crop into rows and a loading trailer is used to transport the green forage to the cowshed. This harvesting system, still used by a substantial number of small farms, is very labour intensive.

In medium to large farms green forage is harvested in a single operation. The combine harvester used in this system is the self-propelled cutting-loader. This self-propelled machine cuts the crop. It is then taken up immediately by the self-loading trailer fitted to the machine. The machine consists of a self-propelled, self-loading trailer with a front mounted cutter. It is also possible to harvest green fodder using a tractor with a front cutting bar and a self-loading trailer. This combination allows the farmer to do without the cutting-loader. The first green fodder cut is made in April and this causes a sharp change in the forage composition of the feed ration.

8.3.2 Hay-making techniques

The prohibition against using silage has forced Parmigiano-Reggiano dairy farms to use hay as a way of conserving forage for use during the

winter. There are three different working systems commonly used in the haymaking process. The first system is traditionally employed in the small farms located on the plain and in the mountains. Six machines are used to carry out the various stages involved in harvesting and transporting the hay: the cutting bar, the hay-tedder, the mechanised hay-rake, the baler, the bale-carrying trailer and the elevating belt.

After the green crop has been cut and turned, a process that involves two consecutive operations, it is left in the field to dry for three to four days. Dry matter loss in this period varies from 30 percent to 40 percent. The raker partitions the hay into rows. In the fourth operation the hay is baled into small rectangular bales each of which weighs about 40 kilo's. A tractor drawn trailer is used to load and transport the bales. These are stacked in the hay barn using a lifting conveyor belt.

This haymaking system is used both by small farms in the plain and in mountains where the steep slopes make it impossible to bale the hay in round bales. The advantage of this system is that it reduces the level of capital investment required and produces bales that are easier to handle in the cowshed.

The second system for harvesting and conserving hay uses round bales. This system was introduced at the end of the 1970s, primarily to make haymaking as a whole less labour intensive. Similar machines to those mentioned above are used but round baling machines collect the hay into bales. Subsequently these large bales are carried by front-mounted forklifts and normal trailers saving a considerable amount of labour per ton of hay during baling and transportation (40 percent and 60 percent of labour requirements respectively). One advantage of this system is that it can be implemented by a single operator although larger investments in machinery are then required. Studies carried out by CRPA show that labour costs are reduced by 50 percent while the cost of the machines per ton of hay increases by four percent only. The economic benefits explain the rapid spread of this working practice in Parmigiano-Reggiano dairy farms.

There are two problems that have arisen from the introduction of round baling machines. It has been established that the quality of the hay produced is slightly less than that produced by traditional methods. It is not so much the technology itself that results in a reduction of quality but the fact that it is often misused. If the machines are not used properly the quality of the finished product is reduced. The round baler requires considerable skill to operate. First, farmers must decide what is the best time to bale and second they must estimate the right amount of pressure

to apply to the round bale. Failure to follow the correct baling procedures will increase the risk of the hay becoming mouldy. The round baler, has in fact, introduced more vulnerability into the forage crop system.

Farmers who have opted for the round bale system have had to build new barns capable of storing these larger bales. The old-style farmhouses with the hay-loft above the cowsheds cannot be used to store large quantities of hay in round bales. Thus while the round baling machine has certainly brought labour savings to the hay-making process fixed costs have increased as a result of the need for new machinery and for new barns.

8.4 Technological development and product specification

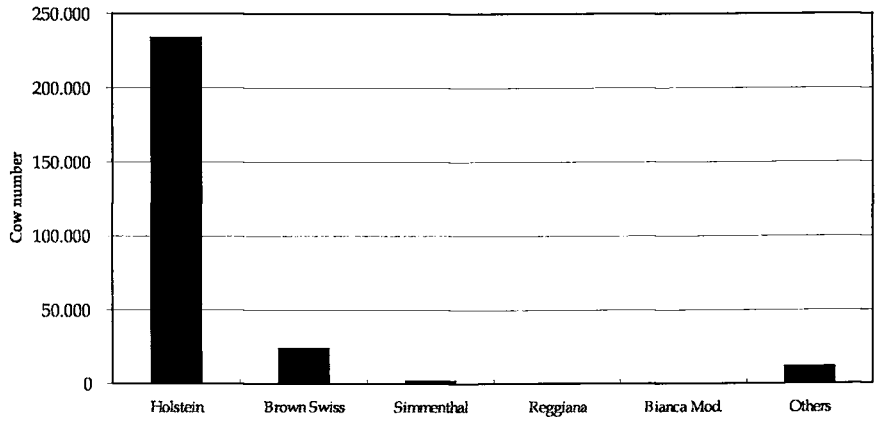
The prohibition against feeding silage together with relatively scarce water resources in the production area has forced farmers to rely on alfalfa as the main forage crop. Fresh alfalfa grass and hay are the main ingredients of the rations fed to dairy cattle. In a number of other Italian dairy systems maize silage has turned out to be the most economical forage crop. This is because it gives a high yield per hectare and has a considerable energy content. The prohibition against using any type of silage roughage has raised milk production costs significantly[5]. The production of hay causes substantial losses during harvesting and its energy content and voluntary intake is lower than of that of maize silage, especially when hay quality is lacking.

Dairy farmers within the Parmigiano-Reggiano system have adopted very differentiated technology packages which, although compatible with the production regulations, limit the chances of bringing down milk production costs even if farm size were to increase substantially.

As we have seen earlier, the Parmigiano-Reggiano dairy farmers are not immune to the 'production' philosophy. Over the last 40 years, because production regulations did not exclude the use of non-traditional traditional breeds, local Reggiana and the Bianca Modenese cows have been gradually replaced in imported Dutch and later American and Canadian Holsteins. Although these breeds have contributed to a significant increase in milk yields and to a rapid diffusion of mechanical milking, they have created new technological bottlenecks. First, these cows need substantially more compound concentrate feed in their rations. During periods in which hay quality declines because of bad weather conditions, the use of compound feeds may compromise the right equilibrium with roughage reducing fat and protein levels in the milk and as a consequence cheese yield. Second, when a comparison is made with

traditional breeds, the milk from Holsteins is found to contain less B-variants of the k-casein. This variant accelerates the moment of coagulation and has a positive influence on the time and density of coagulation. Lactodynamographic analysis shows significant differences between breeds in this respect. Genetic research is being carried out to increase the frequency of these k-casein variants in Holstein milk.

Figure 8.1 Dairy cow population according to breeds



Source: Regione Emilia-Romagna

8.5 The technology of unifeed

The compatibility problem raised by high yielding cows has given rise to much discussion about the advantages and disadvantages of *unifeed* technology. Almost all Italian dairy farms apply the zero-grazing system. This technology has spread widely because it enables farmers to standardise the way they feed their dairy cattle. It is particularly popular in the large maize silage based dairy systems of the Lombardy region[6]. A good mixture of hay, maize silage and compound feeds can be obtained on these latter farms but on the Parmigiano-Reggiano farms water must be added to the mixing wagon in order to obtain the right density of the mixture consisting of only hay and compound feed (Bisaglia *et al.* 1991). Then PR cheese quality will be affected if moulds develop and contaminate the milk because wagons have not been well cleaned.

For a long time, the Parmigiano-Reggiano Consortium banned this feeding technique. There was concern that if feed was given wet the ingredients would be encouraged to ferment[7]. Notwithstanding this ban,

some of the larger farms were impressed by the way the system had been successfully used in the Grana Padano area. Consequently, from the early 1980s, a small number of farmers who were under pressure from ever increasing feed and labour costs started to introduce this technique. For ten years this phenomenon remained a clandestine practice. Its existence was only known to a few and was always denied at the official level. In its 1989 regulations the Consortium referred to the practice warning of the risks involved and recommending that it should be avoided.

Unifeed only emerged from the shadows of December 1995. Without advertising the fact, the Parmigiano-Reggiano Consortium authorised the use of unifeed, although only experimentally. It stipulated that milk from farms using the technique should be processed separately and that it must always be possible to identify cheese originating from these farms. Authorisation involved a special 22-point regulation. Some of the main features of this regulation are mentioned below.

1 Feeds banned under the 1989 regulations cannot be used.
2 The preparation and administration of feed must be organised at least twice daily so as to avoid fermentation.
3 Fresh green forage crops may not be included in the mixture. These can be given separately if appropriate.
4 The raw fibre content of the hay must be less than 35 percent and ash must be less than 12 percent of dry matter. Dry matter derived from concentrate feed must not be higher than the dry matter contribution of roughage. This had already been provided for under the new 1989 regulations.
5 Pieces of cut hay must be between three and six centimetres in length.
6 The proportion of water within the mix must never exceed 45 percent.
7 The mixing trailer must be cleaned at least once a day to avoid the development of moulds.
8 The mixture must be prepared at an appropriate distance from the cow shed.
9 The farms involved must be big enough to guarantee a daily production of at least 1 to 1.2 tons of milk, corresponding to the dairy in order capacity of a cheese-making vat in the cheese to allow separate processing.
10 The raw fat content of the dry matter may be between three and five percent, the dry pulp ash content must be less than ten percent of total dry matter.
11 If the farmers use silage to feed their beef cattle, they must use a different trailer to transport the feed for their dairy cows.

8.6 Artificial hay-drying

One of the drawbacks connected with the haymaking process is that forage is lost during the various operations. Respiration loss, due to the fact that the cut plant continues to respire up to a humidity level of 15 percent (CRPA 1992); losses from leaching; losses due to mechanical processing, and losses arising from fermentation. All in all, the losses can amount to 40 percent of the dry matter produced.

A system of two-stage haymaking was developed to reduce such losses. The green crop is left on the field for a maximum of two days and, after it has been collected it is dried artificially using heated air currents. If the green crop is collected loose and dried in cells, farmers use the machines they also use for harvesting green fodder (cutter, raker and self-loading trailer). If the green crop is rolled into bales and later dried on drying beds, the farmer uses machines identical to those used for round bale hay making. Hence, two different types of hay heating system can be distinguished heating loose hay harvested at about 50 percent dry matter and heating round bales

There are many benefits associated with this system of haymaking. Above all, the amount and quality of hay obtained is far greater that can be obtained through the two systems described earlier. The improved quality of the hay means that savings can be made in the quantities given as feed. Farmers are also able to adapt their old barns to the system and haymaking is less dependent on the weather.

Apart from the energy costs involved in artificial drying, the additional investments required for this system lie in the cost of the drying cells or plates. A costs benefit analysis carried out by CRPA showed that, when compared to the traditional haymaking process, costs exceeded 60 percent. However, an estimated 72 percent more hay was produced. If the higher quality of the hay produced is added to the greater quantity, the study concluded that the investment could be justified on economic grounds.

Despite the economic benefits of investing in two-stage haymaking, the practice has taken off with difficulty on Parmigiano-Reggiano dairy farms. The method was first introduced onto a few farms in the Apennines in Modena province. Resistance to this new technology is probably rooted in the high initial cost of investment required and scepticism about the extent to which total hay production could really be expected to increase. Anyhow, during the last milk price rise in the period 1994-1996 the technology began to extend to the farms on the plains.

One great advantage of this technology is that it makes it possible to obtain high quality hay during the rainy seasons. As the month of May is one of the rainiest months of the year, hay harvesting involves significant risks. Furthermore the high quality of hay makes it possible to reduce the amount of compound feed in the ration. Thus, the extra energy and investment costs inherent in this technology can be met by saving on concentrates.

8.7 Technological innovation in the cheese dairies

One of the fundamental characteristics of this special process is based on the presumption that the milk processed over one time unit (the length of a day) cannot exceed the quantity that can be directly controlled by one person (the cheese-maker) over all processing phases. The history of Parmigiano-Reggiano can be interpreted as technological developments and developments of organisational measures that seek to improve the productive capacity of the cheese-maker, without compromising the final quality of the cheese. Today, there is a wide variety of types and combinations of techniques to be found in the various cheese dairies. Production cannot be expanded beyond a very clear threshold. This is set by the capacity of the cheese-maker to keep the entire productive flow under his control. In this he can be helped by service apparatus such as thermometers for controlling the temperatures in the vats, for example. However, it is only the cheese-maker who can decide when to initiate the different stages of the cheese making process, when to add the triggering whey, break up the curd or interrupt the cooking phase. At an earlier stage, it is only the cheese-maker who is able to decide which milk from which farm should be mixed in the same creaming tanks or in the same vats to balance out the differing and opposing bio-chemical components. These decisions can only be taken on the basis of an instant, personal and sensory understanding of the process to which the raw materials are subjected. These decisions are made on sight and touch judgements and do not rely on instruments. This is another reason why most of the milk for Parmigiano-Reggiano is still collected in churns, and not by tanker. The churn makes it possible for the cheese-maker immediately recognise the origin of a particular consignment of milk. In this way he can use his experience of the different production characteristics on individual farms to optimise the final blending. If he could not do this, the different milks would be mixed at random and there would be little possibility of controling the raw material directly.

Hypothetically, the industrialisation of production would only be possible if the skills of the cheese-maker – defined in terms of his knowledge of the

processes, the relevant legislation and practical skills - could be contained within a complex cybernetic model on the basis of which human expertise could be replaced by that of a robot. Even assuming this was possible, it would only be feasible if there was a highly uniform and standardised raw material and an equally standardised finished product. Indeed, the standardisation of input and output products in the processing system would certainly simplify variability in the factors involved and in turn introduce the possibility of replacing - at least to some extent - person-based skills with an integrated system of 'expert' technology.

Given the current state of affairs such a possibility is extremely remote, because, within the physical and spatial conditions of Parmigiano-Reggiano production, there is a high degree of variability between conditions in the various localities. The discriminating factor with the greatest effect, even if it is not the only one, is the difference between plain and mountain.

Since the mid-1980s, there has been an evolution in the size of cheese dairies and this has had the effect of increasing their individual working capacity. It is clear that when milk processing capacity is less than 2,000 tons per year, the operative dimensions of the cheese dairy are still such that the average cheese-maker can exercise wide and direct control over the entire production cycle. This does not mean, however, that in recent years no cheese-dairies have been constructed with processing capacities that exceed the limit of 8,000 tons of milk per year. There is considerable interest within the associated Parmigiano-Reggiano dairies in such an organisational model and it is seen in many quarters as a socially and economically desirable objective.

Such organisational models are at the limits of the system since increasing the ratio between the amount of milk processed and the individual cheese-maker has effectively reduced the cheese-makers ability to exert personal control over the whole processing cycle. Nevertheless, there is a great temptation to find ways of standardising the process. Indeed, the cheese-maker himself, under 'management stress' will tend to adopt practices favouring the most uniform raw material possible, so as to minimise the element of the unexpected which, when there is a high degree of variability in the milk supplied, becomes an almost inevitable part of the process. In other words, if the intention is to maximise the productive capacity of an individual cheese-maker, it is necessary to ensure the greatest fluidity possible in the processing cycle. This can only be achieved by minimising the spatial-temporal differences in the raw material.

Very illustrative for the technological development of the PR system, is the evolution of the Grana Padano system, which started with a technological package quite similar to the PR system in the fifties and sixties, but went through process of industrialisation and standardisation.

8.8 Evolution of production techniques in the Grana Padano system

The first important change in the Grana Padano system came with the substitution of local cow breeds with Holsteins. The process of *holsteinisation* was possible because the production specification of Grana Padano did not specify that only certain breeds of cows should be used. Farmers deliberately renounced trying to make genetic improvements in local breeds and adopted the productivist model. High yielding cows and semen from premium bulls for artificial insemination were imported first from the Netherlands and then from the United States and Canada. The introduction of the Holstein breed created problems as far as animal feeding was concerned. Holsteins had high-energy requirements and a feeding system had to be developed to sustain these high yielding cows. In the Grana Padano system maize silage was introduced. The introduction of silage into Grana Padano dairy farms meant a further weakening in the relationship between product quality with *terroir* because the development of clostridium spores made it necessary to introduce new techniques into cheese production. This drove the product further along the road towards industrialisation. If we examine the innovations that have been introduced into cheese making, the process becomes clear.

In Grana Padano cheese dairies the use of maize silage lead to the double processing of milk. This consisted of processing the raw milk twice a day and was preceded by creaming off all the milk by natural floating rather than just creaming off the milk from the evening's milking which is the procedure in Parmigiano-Reggiano dairies. This technique is used to get rid of the clostridium spores (Bottazzi 1998). Because the technique is not sufficient to combat the spores, formaldehyde has been introduced as an additive and later lisozyme has found capillary diffusion among cheese dairies. Other dairies adopted centrifuge technology to reduce the presence of spores in the milk.

An even more drastic cost reducing technology has been milk cooling. This allows milk to be collected once rather than twice a day (Grana Padano). Cooling milk is a technology that significantly reduces the typicality of the cheese. When cooling is allowed, it makes it easier for other areas to imitate the cheese. Moreover, this technology has brought a

series of new problems with it to both systems. One of the most relevant being that the milk has a reduced rheological capacity. An almost automatic innovation following up on milk cooling is milk *thermisation,* a procedure for heating milk up to a temperature of 57-68° C for 15 seconds to re-establish the rheological capacity of the milk which may have been lost during cooling (Bottazzi 1997). Some Grana Padano dairies now use this technique but initially they came into conflict with the Grana Padano Consortium because it was in open conflict with product specifications. However, the Consortium has now finally accepted this new technique.

From this overview it is quite clear that the Grana Padano system has gradually moved away from an *artisan* production process, where the key actor responsible for cheese quality was the cheese-maker, to an industrial process dominated by artificial milk standardising techniques and the use of additives. The introduction of one production technique always raises new problems and can lead to the introduction of other related technologies. To a large extent the technological development of Grana Padano has now made it possible to reproduce the product in other parts of the world. Significantly reducing the *artisan* elements in the production process has made this system more vulnerable to imitation. Its degree of typicality has been reduced and its links with the *terroir* has been relaxed.

8.9 Discussion

Technological innovation affects the production-frontier function which is slowly but continually being pushed forward. The motive force is a livestock system in a continual state of evolution. Those pushing hardest are always the farms at the forefront of production, attracted by the tempting example of nearby Lombardy and the Grana Padano production system. The Parmigiano-Reggiano Consortium tries to put a brake on these developments and views with justifiable suspicion and great caution all the technological innovations introduced into the farms of the area.

The examples given above illustrate how the system is under an exogenous pressure that favours standardisation. It can be expected that in future these pressures will only increase. One of the characteristics of an artisan, high quality food system is that its product quality is subjected to variability over time and space because of the small-scale nature of production and seasonal climatic variations, which are not levelled off by an industrial process. As Parmigiano-Reggiano cheese production involves over 15 percent of Italian milk production, it is not servicing a niche market made up of high-income consumers or 'connaisseurs'. To a

certain extent Parmigiano-Reggiano cheese enters a mass consumption market in which quality standardisation is extremely important.

The Parmigiano-Reggiano dairy farms rely upon very differentiated technology packages, which have their roots in different styles of farming: the strategic behaviour of farmers and how they link farm practices to markets and to technological development in specific and deliberate ways (Van der Ploeg 1994). The introduction of exogenous elements is subordinated to the need to maintain the originality of the product. The power of the Parmigiano-Reggiano cheese system is its ability to incorporate exogenous inputs without changing its fundamental characteristics. Each new technology gives rise to a debate about opportunities for introduction and creates tension between the actors in the system. Research is then carried out into the impact such new technology will have on the final quality of the cheese. Research activities at the local universities and research centres screen externally and internally developed new technologies to assess their compatibility with the Parmigiano-Reggiano system and develop new techniques in an effort answer on-farm problems. Research results are then translated into new regulations published by the *Consorzio*. In this way production regulations create a framework within which technological development can take place. However, the differences referred to above and the different styles of production techniques that have been innovated have not altered the original basis and uniqueness of the product. In other words the Parmigiano-Reggiano system is guided by a *technological paradigm* according to which 'innovative activities are strongly selective, finalised in rather precise directions and often cumulative activities' (Dosi 1988). Referring to Dosi once again 'firms cannot freely dip into a general stock or pool of technological knowledge. Technological bottlenecks and opportunities, experiences and skills embodied in people and organisations tend to **create** context conditions which are country-specific, region-specific and even company-specific' (Dosi 1988).

Notes

[1] The different styles of farming present in the PR production area will be dealt with in the next chapter.

[2] I refer here to proposals to come to an increase of the labour productivity in the cheese dairies by means of cooling of the milk down to 4°C and a flow production of PR cheese in continuum.

[3] The clearest example of this type can be seen in the material impossibility of conforming to the 1:1 ratio between the dry matter in animal feed and that in the untreated forage crops with respect to a cow with a daily milk production of 40 kilo. This was the ratio

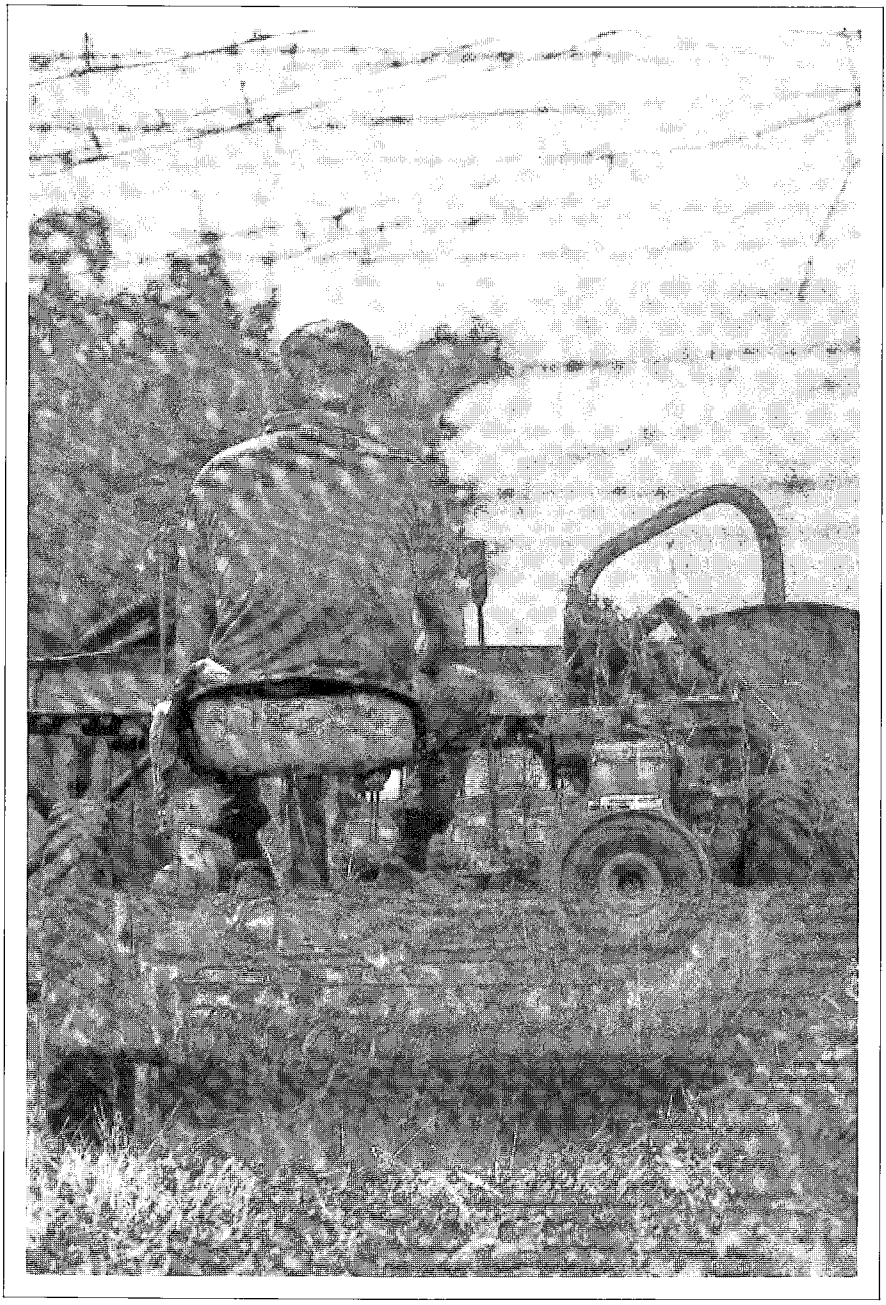
recommended by the Consortium in the 1989 up-dating of its regulations. Indeed, the animals concerned would not be able to digest a sufficient quantity of forage to meet their needs. In such cases, the farmer is forced to resolve the problem by increasing animal feed production, against the rules of the Consortium.

[4] It is perhaps of interest to note that in the regulations of 1973 average milk production for a cow according to the Consortium, was 15 kilo per day. In the up-dated version of the regulations of 1989 a daily production of 20 kilo was considered 'moderate'.

[5] In chapter 10 an analysis will be made of the production costs of milk destined to PR cheese.

[6] Unifeed was being used in the Grana Padano production zone from the middle of the 1970s, where it is considered entirely legitimate by the related production regulations. It is only the long ban imposed by the Parmigiano-Reggiano Consortium which has meant that in this zone Unifeed is still considered an innovation.

[7] The last occasion on which the Consortium repeated its ban was in January 1990 confirmed in a document produced in 1995.



9 Analysis of the Firm Behaviour

9.1 Introduction

In the previous chapter various firm strategies have been mentioned. These find expression in different styles of farming. We will now analyse in detail which kind of farming styles can be distinguished within the Parmigiano-Reggiano system and examine their implication for the future development of Parmigiano-Reggiano cheese production. In 1980 and 1981, an analysis of the heterogeneity and styles of farming was carried out by Bolhuis and Van der Ploeg in the same research area. It was based on in depth interviews with farmers and on accountancy data (Bolhuis and Van der Ploeg 1985). In their work they questioned why and how, within a homogeneous agricultural area (see Hayami and Ruttan (1971)), extremely differentiated farm development patterns could be distinguished, each with its own internal logic.

Subsequent research in the period 1982-1985 sought to identify these different styles of farming. Both studies obtained similar results. They identified a group of dairy farms that were highly dependent on the price fluctuations in input markets and who had delegated some reproduction functions to outside institutions. They also found dairy farms that had deliberately chosen to be as autonomous as possible. These followed a strategy characterised by a low rate of incorporation into input markets and a low rate of integration into the Technological Administrative Task Environment (TATE) (Benvenuti *et al.* 1988).

Van der Ploeg has defined a style of farming as being the product of a specific structuring of farm labour, where farm labour is defined as the interaction between the direct producer, his or her objects of labour and the means of production (Van der Ploeg 1990). In this chapter we will build on this work in order to examine whether new styles of farming have come into being and analyse what consequences this may have on the future development of the Parmigiano-Reggiano system.

The second part of this chapter will deal with cheese dairy firm behaviour. Using the methodological framework developed by Porter, we will examine how cheese dairies establish their economic relations with cheese maturing firms and the farmers who deliver their milk and how they manage the production process. Finally, we will analyse different typologies of cheese maturing firms focusing on the social and economic behaviour of the actors in Parmigiano-Reggiano system.

9.2 Dairy farms

The production of cow's milk for the manufacture of Parmigiano-Reggiano cheese is seen by all farmers as a way of obtaining an income sufficient to satisfy the material needs of their families. The manner of production however, may vary from farm to farm depending of their approach to farm management. This variety in approach is itself linked to the differing intermediate objectives individual farmers set themselves. Farmers construct their system of objectives according to the differing values they personally attribute to each partial goal. While the improvement of their own and their family's well-being represents the primary aim of all farms, it is not always equated with the simple objective of maximising farm income. The fact that there is no exact correlation of objectives between different farmers leads to a series of differing responses to the pressures exerted by the environment. Once one goes beyond the surface impression given by reactions of concern for economic or seemingly random factors, consistent characteristics begin to emerge. These can be truly described as farming styles or patterns.

Such farming patterns will have grown in symbiosis with the historical development of the farm itself. They find initial expression in the manner in which the work itself is carried out. Some farmers, for example, prefer to work in a cow shed where the animals are tied up, others prefer a free-range cubicle house. The former is more labour-intensive than the latter. Such differences in style also carry with them important variations in the connotation associated with quality since each possesses its own set of rules that define the 'right' way of carrying out the jobs that have to be done.

Another important point of difference between farming styles is that they differ in their relations with the various farm-input markets. Some farmers prefer to produce all their hay on-farm in order to avoid dependence on fluctuating market prices. Alternatively they may be motivated by the desire to keep direct control over the quality of the hay and can do this best when it is produced at 'home'. Such farmers will

probably keep their bank loans to a minimum in order to make the financial management of the farm easier to control and less subject to variations in interest rates. These farmers follow, as Van der Ploeg observed, a pattern of relatively autonomous, historically guaranteed reproduction. Others, though, believe that the development of the farming business should not be limited by the level of their own personal financial reserves and that they should, to some extent, be able to take advantage of bank mortgages. The buying of forage and the systematic use of outside suppliers is representative of the logic of this philosophy. It involves a greater recourse to hired labour, to the input markets of the means of production and to financial markets.

Even though empirical observation of the current types of farming pattern may not always match these guiding models and lack the internal, logical consistency of the model, nevertheless it is clear that the development of dairy farming follows a variety of different routes. Such guiding models or 'maps' can be used to trace the general direction of the various paths being followed but, within these limits, each farm will still have its own practices based of its internal logic. These will be constructed as a result of the interplay of entirely subjective aims, the prioritisation of the means required to achieve them, and elements relating to the objective situation of the business.

Diversity in farming patterns can be partly attributed to farm size and partly to the business's financial resource structure. It should not be forgotten, however, that the size and structure of a farm is itself the outcome of strategies and decisions adopted and taken in the past. Dairy cattle livestock farming, as with any productive industry, can be seen as a collection of producers following different strategies to improve the well-being of their family group. Thus it should not be taken for granted, for example, that all producers will seek to maximise income. Some will be prepared to accept a lower level of personal income, because they attach more importance to other facets of the concept 'well-being'. These may include free time, keeping family members involved in working on the farm and the welfare of the cows – in particular making sure that they remain healthy, clean and reach high levels of production. Considerable and significant importance is given to the pride derived from possessing a high quality herd. It justifies an increase in expenditure even if income is reduced as a result.

Below we will present the results of research that focused first on the variety of farming patterns typical of dairy farms situated within the Parmigiano-Reggiano cheese producing area, second on the strategies farmers used to reach the objectives they had set themselves, and finally

on the differing views held about the future of the Parmigiano-Reggiano production system. This research involved a sample of 45 dairy farmers on the plain and 48 dairy farmers in the mountains and drew on accounting data from the period 1989-1993 as well as structured interviews with the farmers.

9.2.1 Identification of the farming patterns

The farming pattern followed by individual farmers is a product of technical, structural and social factors, each of which plays a particular role in guiding the development of the agricultural business. The external financial and institutional environment forms the pre-existing conditions within which farm work is structured (Van der Ploeg 1990).

The structural and technical characteristics of the farm are extremely important in the identification of farming patterns. A small farm normally uses a different variety of methods to increase income levels than a large one. Of greater importance in the specific context of working practices on a dairy farm, however, is the worker/cow ratio. This ratio is not left to chance but is the result of conscious management decisions taken over the course of time. In some farms the introduction of labour saving technology has increased the cow/worker ratio enormously. At the same time, other farms have chosen to opt for a more direct and personal control over the productive process and are not prepared to put so much trust in the mechanisation and automation of agricultural operations. It will be clear that the preferences reflected in these two choices have important repercussions for the cow/worker ratio.

Another technical element that can help us identify the farming pattern prevalent on a particular dairy farm is the milk yield per cow. In the Netherlands, many studies into this feature (Antuma *et al.*1993; De Bruin and Van der Ploeg 1991) confirm that farmers have a very precise idea of what is an appropriate 'ceiling' in this respect. The unit milk yield is, therefore, not solely dependent on the farmer's technical skills in selecting, feeding and looking after the herd, but also on the objectives that he or she has consciously set for the business. It is also the result of a deliberate decision about how far to 'push' the herd. Some farmers are happy with a cow that does not reach its maximum potential because they feel that they will be able to restrict feed and treatment costs in this way. Others, however, try to keep their foot on the accelerator, believing with equal conviction that an increased production of milk will compensate for any increase in costs.

The combination of these two aspects of the productive process (scale and intensity) provide an elementary method of classification. Even so, these two variables by themselves are not sufficient to provide an exhaustive description of farming patterns. They must be combined with other technical and structural indicators that will strengthen their distinguishing role. Sixteen technical and economic indicators have been taken into account in the process of identifying farming strategies[1]. These summarise the principal technical and structural characteristics of the farms that make up the sample. A principle component analysis of these indicators has been carried out in order to identify the underlying structure.

Table 9.1 Principle component analysis applied to 16 technical and structural parameters of PR dairy farms (n=45)

Description of variable	Variable	Factor 1 Structure	Factor 2 Milk production intensity	Factor 3 Intensity of land use
Number of cows	VAC2T	0.83467		
Cows per Working Unit	VACULS2T	0.90662		
Hours per cow	ORVAC2T	-0.93306		
Percentage of monetary costs	INCCEL2T	0.76030		
Fixed costs per cow	CFBVAC2T	-0.53969		
Replacement rate	RIMO2T	-0.57672		
Milk yield per cow	RES2T		0.82963	
Variable costs per cow	CVBVAC2T		0.83967	
Concentrates per cow	MANVAC2T		0.80090	
Veterinary costs per cow	VETVAC2T		0.47673	
Working capital per cow	CAGVAC2T		0.70355	
Kg. Concentrates per kg milk	MANPRO2T		0.55505	
Purchase of roughage per ha forage crops	CFOSFO2T			0.93695
Purchase of roughage per cow	CFOVAC2T			0.87522
Share of contracts labour in machine costs.	NOLMAC2T			0.42236
Cows per ha forage crops area	VACSFOR2T			0.69967
% Variance explained by factor		26.6	21.8	15.4

The first two factors referred to above were used in the identification of the main categories involved in this study: size and intensity. Taking these two factors together it was possible to identify four farming patterns. Each was defined by using the average values of the points awarded per factor (the average being value 0) as a starting point. When the 45 farms were divided into four groups the following pattern of distribution emerged:

- Pattern 1 - large, highly intensive farms (9 farms).
- Pattern 2 - large, extensive farms (10 farms).
- Pattern 3 - small, intensive farms (12 farms).

- Pattern 4 – small, extensive farms (14 farms).

From the structured interviews carried out with the dairy farmers, clear styles of farming emerged. Each style had its own internal logic. The above subdivision is not simply a statistical exercise, but reveals completely different ways of farm development and farm strategies. Different routes have been chosen to meet a common goal: the generation of a decent income for the dairy farm family.

9.2.2 The vanguard farms (high intensity and large size)

There are nine farms in this category. They have adopted a strategy that combines the advantages of high intensity milk production with those inherent to a large farm. On the plain, the average herd size of these farms is 63 dairy cows. These give an average annual milk yield of 7,500 kilo per cow. These values are higher than any observed in the other farming patterns. Even though both these objectives are pursued in a unitary vision, yield represents the most dynamic indicator over time for the case histories examined in this research. Over a period of three years, milk production per cow increase by five percent, the highest rate in any of the four groups of farms. The small farms with intensive production saw an increase of 1.7 percent in unit yield. In the other farms, where this objective has a lower priority, a slight decrease in yield was noted.

The vanguard farms spend relatively more on feed, medicines and veterinary assistance to ensure increased yield per unit. This means that variable costs per cow are pushed to high levels. Farmers in this leading group are not interested in imposing expenditure limits so long as they are able to obtain the maximum production per cow. Indeed, these farms spend more than any other and they also purchase forage

In addition to a continuous increase in unit yield, these large intensive farms consider an increase in size, structural improvements and labour saving measures as benefiting their income generating capacity. On these farms one cowman is able to manage some 25 dairy cows as well as young breeding cattle. It is clear that this is only possible with the automation of milking, administering feed, and clearing manure.

Combining intensive farming techniques and scale generates a higher income per unit of labour. This in turn may result in a sufficiently high level of income to reduce the significance of the problem of production costs. In fact, this group of farms does not have the lowest overall production costs. Their high unit production is not sufficient to

compensate for the higher variable costs. The lowest cost per litre is achieved on the large, extensive farms (Pattern 2).

The strategies adopted by the leading farms involve greater recourse to the financial and technical markets – primarily those of animal feed and labour.

Table 9.2 Main technical and structural characteristics of dairy farms in the plains

		Vanguard farms	Large Extensive	Small Intensive	Marginal farms
Number of farms	N.	9	10	12	14
Number of milking cows	N.	63	47	23	29
Milk production per cow	Kg	75	56	66	53
Increase milk prod. per cow	%	4.9	-0.6	1.7	-1.2
Utilised Agricultural Area	Ha	35	29	13	19
Forage crops	Ha	32	23	12	17
Cows per ha forage crops	N.	2.0	2.0	1.9	1.7
Annual Working Units	N.	3.6	2.7	2.1	2.7
Working hours per cow	Hours	106	98	181	163
Working capital per cow	Mln lire	5.8	3.8	4.7	4.1
Variable costs per cow	Mln lire	2.9	1.8	2.2	1.7
Fixed costs per cow	Mln lire	2.7	1.9	3.0	2.6
Concentrates per cow	Mln lire	1.6	0.9	1.3	0.9
Veterinary costs per cow	000 lire	177	112	153	122
Purchase of forage per ha	000 lire	2,196	1,680	1,763	1,549
Purchase of forage per cow	000 lire	948	701	823	723
Monetary costs per kg milk	000 lire	506	378	392	374
Percentage monetary costs	%	66.3	58.8	49.2	46.0
Gross margin per AWU	Mln lire	62.4	59.7	35.0	32.8
Gross margin per cow	Mln lire	8.8	8.3	8.7	7.5
Gross margin per hectare	Mln lire	17.8	18.6	17.8	15.5
Net income per family AWU	Mln lire	36.6	40.2	23.1	23.6

This pushes explicit monetary costs up to the extent that they account for about 66 percent of total costs. While this path leads to higher income, the farms in this group are also those most vulnerable to fluctuations in the market price for animal feed, hay and labour. This greater dependence on the market and their greater 'sensitivity' to external forces explains the dramatic falls in incomes that occurred in 1992 when the price of milk fell. The guiding principle behind this farming pattern can be compared to that adopted by the '*grands intensif*' farms hypothesised by Mathal in 1981 where there was a strong trend towards the 'holsteinisation' of dairy cattle. While the continuing intensification of production is to a large

extent based on the quantities of feed administered, it is primarily dependent on genetic selection. The financial vulnerability of this model arising from its greater degree of incorporation into inputs markets is demonstrated by the drop in income levels experienced during the economic crises that lead to the collapse of Parmigiano-Reggiano prices.

In previous research carried out in the 1980s there was no evidence that this farm style was prevalent in the Parmigiano-Reggiano production area. A high degree of incorporation into input markets together with the considerable influence TATE institutions exerted on the farm decision-making process resulted in an incomplete exploitation of farm resources during this period (Bolhuis and Van der Ploeg 1982; Benvenuti *et al.* 1988). In the 1990s a typology of large intensive dairy farms has emerged and its weight on the total number of dairy farms is increasing.

Briefly, the following observations can be made about this style of farming:

1 The strong points of the vanguard farms are:
- farms of substantial size;
- high production of milk per cow;
- high remuneration of labour.

2 The weak points of this kind of farm are:
- greater vulnerability due to a greater dependence on input markets;
- greater instability in income levels.

9.2.3 The large extensive Farms (low intensity and large size)

This pattern typically involves a farm with a large- to medium-sized dairy herd. During the period when this study was being carried out, there was a substantial increase in numbers of lactating cattle on this type of farm. As herd size grew, production per cow remained constant at a level of 5,600 kilo milk per cow per year. The relatively low unit yield for this group can be explained by the low level of expenditure on concentrates. The other costs involved with milk-cow productivity were also relatively low. No other group spends so little on veterinary services and medicines. The variable costs per cow are thus very low.

High productivity levels for work carried out in the cow-shed go hand in hand with large farm size. A producing cow on these farms requires, on average, less than 100 hours of work per year. This is in contrast to the 181 hours required in farming pattern 3 (small intensive). The development strategy adopted by the large extensive farms is related to a constant

increase in size without any noticeable increase in the productivity of the cows.

These farms have the highest long-term debt exposure. This statistic is of considerable importance because it indicates reliance on external financing to make it possible to invest in labour-saving technology. However, this type of farm has less recourse to external markets than large intensive producers. Large extensive farms have significant levels of income, the income/worker ratio is the highest of all four styles of farming and no other type is able to match the low level milk production cost. The guiding principle followed on these farms is that costs related to cow productivity should be kept to a minimum but that technological investments able to produce a steady reduction in labour costs should not be neglected. The farmers in this category accept an average yield from their cows that does not exceed average standards. They believe that an increase in the productivity of the herd may give rise to costs that they are unlikely to recover.

1 The strong points of this category are:
- high work productivity obtained through the use of labour saving technology;
- low production cost for the milk and high remuneration for work inputs;
- variable costs per cow kept low;
- greater diversification in cropping plans.

2 The weak points of this category are:
- extensive recourse to financial markets, creating greater dependence on external factors;
- lower level of employment in the cow-shed.

9.2.4 Small intensive farms (high intensity and small size)

Herd sizes on these farms are relatively small (an average of 23 milk producing cows) and there was no change in average numbers during the period covered by the study. These are the smallest farms of the sample as far as total land area is concerned for no more than 13 hectares are cultivated. The number of cattle kept per hectare of forage crops is higher than on the marginal farms which makes it necessary to buy forage more frequently. Because the total amount of land on these farms is small, farmers seek to defend their market position by relying on high milk yields per cow. Dairy cows on large, intensive producer farms produce more – between 6,500 to 6,700 kilo of milk per year – than the farms in this small intensive group.

The intensification of milk production, which is the dominant strategy on this type of farm, requires a cropping plan that makes the greatest possible use of the land available. As a result 92 percent of the land is used for the cultivation of forage crops.Preference is given to a rotation of Italian rye grass with alfalfa. Another indicator of the intensification strategy is the type of rations feed to the dairy herd. Some 42.5 percent of the forage provided is hay from graminaceae crops known for their high quality levels. In all other categories the proportion of hay from graminaceae does not exceed 30 percent.

Looking at these farms from the point of view of income generation, it can be seen that the income/worker ratio is not high. In fact levels are similar to those obtained in the marginal farms (Pattern 4). This is the result of a low cow to worker ratio. The greater productivity of the dairy cows cannot compensate for the lower ratios because of the small scale. Even the gross margin per unit of labour employed is only slightly greater than that achieved on marginal farms. This would appear to show that the strategy of seeking to intensify milk production does not result in a significant improvement in income generation on these farms. The greater unit production is largely cancelled out by greater costs.

1 The strong points of this type of dairy farming are:
- the management of the farm is carried out mainly by family members, providing greater flexibility when periods of crises have to be overcome;
- high level of technical efficiency in running the cow-sheds (comparison should be made between unit yield of the cows with those relating to the variable costs incurred in achieving such a yield);
- low level of debt exposure, in particular in the short-term, and more generally, a lower level of dependence on the market;
- more labour intensive working practices in the cow-sheds in relation to the number of cows.

2 The weak points of this type are:
- relatively low level of income generation, leading to reduced levels of employed capital;
- higher total cost of milk production, due largely to a higher labour input per product unit. Even so, in terms of explicit monetary costs per kilo of milk the increased expense of production as against that of the other farming types is relatively modest.

9.2.5 Marginal farms (small and extensive)

In a number of respects these farms demonstrate characteristics that leave them far behind. Clearly such a categorisation should be understood in relative terms, that is, in relation to the average characteristics of the entire sample group of farms being studied. On average these farms have about 29 dairy cows and an average of 19 hectares of cultivated land. The net income generated by each member of the workforce is among the lowest in the entire farming sample and milk yields per cow do not exceed 5,500 kilo per cow per year. The farmers in this category tend to keep costs to the minimum. The variable costs per cow, in terms of feed, veterinary costs and forage, are very low when compared with the other types.

Little recourse is made to external input markets. The level of explicit monetary costs compared to total costs does not exceed 50 percent. This goes to show that one half of the resources used in the productive process is generated within the farm itself. A detailed analysis of the level of contacts between these farms and the input markets shows that the use of agricultural credit is low; they use outside suppliers as little as possible, and they try to produce as much of their own forage as possible. They do not follow an intensive pattern of farming and are far from large (traits that tend to make these farms appear marginal). The youngest members of the workforce are no more than 37 years of age. This statistic conflicts with the most common stereotype of this type of farm that is that they are usually run by older farmers who are ready to retire at the first opportunity. The capacity of these farms to survive depends on the emphasis placed on keeping costs to a minimum. This strategy works to absorb the shock of periods of market crisis.

1 The strong points of this type of farm are as follows:
- low level of contact with the external specialist markets, meaning that they are less vulnerable to price fluctuations;
- fairly youthful work-force.

2 The weak points of this farming type are:
- low level of income generation from the work-force and capital employed;
- high total unit production cost.

Table 9.3 Future prospects of dairy farms in the PR supply chain

Question	TYPOLOGY				
	Vanguard farms %	Large extensive %	Small intensive %	Marginal farms %	Mountain farms
In this area your farm is considered to be					
A small farm	0.0	0.0	62.5	22.2	5.4
A norm farm	0.0	70.0	25.0	55.6	64.9
A vanguard farm	100.0	20.0	12.5	11.1	27.0
A leader farm	0.0	10.0	0.0	11.1	2.7
Which is the most important worry about your management?					
The market of PR cheese	50.0	60.0	66.7	33.3	51.7
Labour costs	25.0	20.0	16.7	33.3	17.2
Sanitary problems	25.0	20.0	16.7	33.3	17.2
How do you evaluate a herd increase without buying land?					
Good option	28.6	20.0	50.0	77.8	21.0
Bad option	71.4	80.0	50.0	22.2	78.9
How do you judge the difference between the PR system and the Lombardy dairy system?					
The PR system is better	50.0	80.0	87.5	66.7	73.0
The PR system is worse	50.0	20.0	12.5	33.3	27.0
If the price of PR goes down again to the 1993 level, what do you do?					
I will continue	71.4	40.0	50.0	75.0	50.0
I would change to industrial milk	28.6	50.0	0.0	0.0	7.9
I would stop farming	0.0	10.0	50.0	25.0	42.1
Which farms will survive after 2000?					
Only farms with more than 100 cows	57.1	50.0	62.5	55.6	50.0
Both types of farms	42.9	10.0	25.0	33.3	50.0
Mainly farms with 50 cows	0.0	40.0	12.5	11.1	0.0
Which farms survive after 2000?					
Farms with more than 9,000 litre milk per cow.	71.4	30.0	37.5	44.4	71.0
Both types of farms	14.3	10.0	12.5	0.0	15.8
Farms with more than 7,000 litre milk per cow.	14.3	60.0	50.0	55.6	13.2
Which farms survive after 2000?					
Farms with hired labour	57.1	30.0	37.5	55.6	13.1
Both	28.6	30.0	37.5	11.1	13.1
Mainly family farms	14.3	40.0	25.0	33.3	73.8
Are you in favour of the introduction of UNIFEED on PR farms?					
No	28.6	30.0	50.6	55.6	55.2
Yes	28.6	50.0	25.0	22.2	31.5
I do not know	42.9	20.0	25.0	11.1	13.2
Are you in favour of the use of industrial by products in feeding?					
Yes	28.6	50.0	12.5	0	18.4
No	71.4	50.0	87.5	100.0	81.6

9.3 Future prospects for the farming sector

Prospects for the future were studied by carrying out a market opinion survey and analysing the consequences of price trends on farming management policies. Particular attention was paid to the farmers' vision of what might happen to the Parmigiano-Reggiano production system in the future. From the responses obtained it has been possible to build up a picture of their points of view. It is interesting that these responses provide yet another dimension that can be used to distinguish between the four farming patterns.

9.3.1 The vanguard farms

Managing a large farm with high unit production levels and where one stockman is responsible for looking after 25 cows and also young breeding stock requires a great deal of concentration. Farmers complain that, by the end of the day, they suffer from mental fatigue. This stress, however, is also viewed as an indicator of their privileged status. True, they admit to experiencing these levels of fatigue but there is an element of pride in the admission. For example, none of the farmers responsible for running these high production farms had any doubts about classifying their own farms as 'progressive'. They see their own farms as models which other in the area could well emulate. Physical fatigue is seen as a feature of unpleasant work, the work of the other farmers being seen as nothing more than that of manual labourers. They see themselves as the best of their kind, authentic 'entrepreneurs', who have to work hard and work with their heads.

In common with other farmers, their principal concern as far as the financial management of their farms is concerned is the condition of the Parmigiano-Reggiano market. They are aware that they have made choices that are difficult to reverse. This means that if there were a crisis involving Parmigiano-Reggiano they would experience the threat of failure not simply in financial terms but in personal terms as well. This is because it would show that they, who have portrayed themselves as model farmers, had failed to identify the symptoms of crisis in time. The farmers running these vanguard farms do not approve of the development of dairy farms increasingly detached from the land. They attribute a high value to the on-farm production of forage crops seeing as generating income in the long-term. Farmers are critical of being too heavily dependent on the hay market because it makes them too vulnerable financially and second, because of the environmental problems that might arise on farms that are too detached from forage crop production.

Their outlook on the Parmigiano-Reggiano system contrasts sharply with the views expressed by farmers working within the other farming systems. Fifty percent of the farmers in the vanguard category argue that the differences between the dairy farming system in the Emilia Romagna region, where Parmigiano-Reggiano dominates, and the system more common in Lombardy where a more industrial type of farming is the norm, present obstacles rather than advantages to livestock farming in Emilia Romagna. The large dairy farms in Lombardy, working within the more elastic requirements of Grana Padana cheese production or entirely without restriction if they are producing for the industrial milk market are identified as working in a kind of privileged area and are regarded by some as providing a good example.

This view is confirmed by the fact that almost 30 percent of vanguard farms would be interested in the possibility of supplying industrial milk if the recent crisis in the Parmigiano-Reggiano market were to reoccur at similar levels of intensity. This percentage is only exceeded by those running large, extensive farms. None of the small farmers contemplate changing to industrial milk production. They would rather close down their farms altogether.

When asked about what type of dairy farm would survive in the twenty-first century, farmers in this leading group based their predictions on a concept of a farm with herds of 100 dairy cows and an average yield of 9,000 kilo of milk per cow. These figures were the highest in terms of the scale and intensity of farms envisaged by any of the interviewees in the study. Their image of the ideal farm strengthens the characteristics particular to their group and is consistent with the management strategies they themselves have adopted. It should be said, however, that not all farmers in this group were such strong supporters of ever-increasing size. Some, fearful of losing the edge they currently held over their competitors, saw a place for farms with herds of 50 cows, arguing that it was possible to envisage co-existence between larger and medium-sized farms. So far as the production figure of 9,000 kilo per cow is concerned, views were more unanimous indicating the greater value these farmers placed on intensity of production.

Finally, vanguard farmers gave their views on technological developments in feeding techniques. Almost half of the dairy farmers interviewed were against the introduction of the unifeed system, the remaining 50 percent were in favour of it. This division reflects the intensity of debate over this issue. Examining the opinions expressed by the vanguard farms one notices that while many of them are uncertain

about its benefits, only a small minority is against its introduction. They also show less resistance to using industrial by products to keep farm costs low.

From this overview it is quite clear that vanguard farmers look with a considerable degree of envy at the farming operations of their colleagues on the other side of the River Po. They appreciate the freedom they have to chose between a wider range of technologies and feed ingredients and many of them consider Parmigiano-Reggiano production regulations to be an obstacle to the full development of their farms. We should stress here that this view of the Parmigiano-Reggiano system, held as it is by an important group of farmers, may carry serious implications for the way production develops in the future.

9.3.2 Large extensive farms

When comparing their own situation to the conditions commonly found on vanguard farms, large extensive farmers claim to suffer less stress and consider themselves to be part of a largely normal farming enterprise. In view of the fact that the production levels achieved by the cows create fewer health and feeding problems, there is less need for intensive checks and controls. As a result farmers are less worried about making mistakes in the way they run their farms. They see the concept of large scale as being primarily a question of simplifying the productive process and they are strongly antagonistic to the concept of complexity. This is the main feature that distinguishes large extensive farms from their high-production colleagues.

To a greater extent than their colleagues in the vanguard group, these farmers do not approve of a farm where increases in production are not matched by increases in the land area under forage crops. Most of those interviewed stated it was important to maintain links with the land. The large extensive farms had some of the lowest ratios as far as the cost of forage crops purchased from outside relative to the percentage of farm land devoted to the cultivation of forage crops were concerned. In other words, they have been able to organise a large-scale enterprise precisely because they have been able to rely on substantial land resources.

As far as the Parmigiano-Reggiano system is concerned, large-scale extensive farms value the technical and structural differences between the system in Emilia Romagna and the system in Lombardy very positively. In this respect, it should not be forgotten that these farms, even while working under an extremely restrictive production discipline, are those best able to limit labour costs. This places them in a good competitive

position both in Emilia Romagna and in Lombardy. As a result, they are in a less disadvantaged position when a comparison is made between the two systems. Nevertheless, if there were to be a repetition of the crisis in the price of Parmigiano-Reggiano cheese, only 40 percent of this group would continue to produce for the Parmigiano-Reggiano system. This attitude can be explained by the greater financial exposure of these farms. Their financial health is more vulnerable to the effects of reduced payments over a longer period of time a feature characteristic of periods of crisis.

The view of the future proposed by this group of farmers is that the farms that supply milk for Parmigiano-Reggiano production are characterised not so much by size, but by the modest levels of production achieved by the herds. Only a minority of those running large-scale, extensive farms predict a future where high-performance livestock will play a prominent role. Once again, we see the guiding philosophy that typifies this pattern of farming – standardisation of the productive cycle is made easier by the introduction of 'low intensity' repetitive processes that do not have stressful repercussions for the way the farm is being run. All must be easy, simple and relaxed. It is not simply chance that make these farmers more optimistic about the future of the family business while other see matters far more pessimistically. If this extensive character should become the farming pattern of the future, progress will be achieved in small steps and farm-work will proceed at a more tolerable pace. The workforce – farm family members included – will probably find this more acceptable and desirable than scenarios that involve increasingly demanding and oppressive working practices.

9.3.3 The small intensive farms

In these farms, the small size of the farm and the relative availability of labour make it possible for the farmer to meticulously check each individual high-producing cow. Even so, a limited amount of automation in the cowsheds and fields means that work is seen purely and simply in terms of physical fatigue. Each farm worker is responsible for looking after 13 dairy cows as opposed to the 25 cows being managed by vanguard producers and large-scale extensive farmers. Small intensive farmers define themselves as 'small' farmers and rarely in terms of 'normal' or 'progressive'. This response strongly reflects their sense of identification with their own particular farming type. As we shall see, this is not the case for those working marginal farms.

Bound as they are to producing milk for Parmigiano-Reggiano, farmers running small but intensive dairy farms depend heavily on the good

fortunes of Parmigiano-Reggiano. This preoccupies them much more than it does the other farmers interviewed in the survey. Small intensive farmers see the differences between the system in Emilia Romaga and Lombardy as being beneficial to a far greater extent than the farmers in any of the other groups. Because of the small size of their farms they feel they are the most faithful interpreters of the Parmigiano-Reggiano tradition and they see themselves as more Emilian than all other Emilians. They see the steady increases in scale as challenging the traditions basic to their identity and undermining their capacity to be faithful to a culture that only they can truthfully interpret. This is why none of these farmers has ever considered the idea of diversifying into industrial milk production in times of crisis. For them this would represent an unacceptable betrayal. It would be better to close down the farm.

It would appear that the motives that fuel these replies are not those of strict economic return. More than anything else they are an expression of an extremely strong local culture although there is a clear note of desperation too for many farms that have had to close down in the Parmigiano-Reggiano area. Small intensive farmers talk of those who survive and are aware that their future is uncertain and problematic. However, it is precisely for these reasons that they are all the more hardened against, and antagonistic to, any type of compromise. Loyalty to the Parmigiano-Reggiano system is consistent with affirmations of identity and self regard and involves a grinding struggle that has to be re-fought each day. These are the true purists of the system. Without Parmigiano-Reggiano they would have no future and this is the source of their fears.

The first of these fears is extremely explicit. According to the opinions obtained from this group, the farm that will survive in the twenty-first century will be quite different from their own. The majority foresee a future dominated by large-scale farms that do not achieve excessive unit production rates. The family-run farm does not, in their view, have good prospects. Only a quarter of those interviewed considered that it had any chance of survival. They do not see themselves as having any place in this future. They see the Parmigiano-Reggiano system falling into the hands of their 'enemies'. It becomes obvious that their predictions reflect a great pessimism and a great fear of being completely cut out. The large-scale, extensive farms will win out and these farms are the antithesis of their own.

Small intensive farmers have a great pride in their status – they are small but they excel – and this coincides with their strong identification with the Parmigiano-Reggiano system. The concentration on intensive farming is

better explained in the context of this outlook, as a qualitative response to a situation that imposes insuperable quantitative limits - those of the advantages of scale. Since they cannot compete on the basis of quantity, they have to put all their eggs in the quality basket. The high production averages of their herds are not simply their chosen strategy but also their emblem of excellence. This is their ensign and from it they derive their sense of self worth. As with all artists, the small intensive farmers have cultivated their own myth: when we are no more, there will be none capable of matching our quality. In this sense their prediction that they will be unable to survive functions of an epitaph, and it is one in which they celebrate themselves.

9.3.4 The marginal farms

The replies from this group provide a picture that, on the surface at least, is very similar to the one sketched by the small but intensive farms: strong loyalty to the Parmigiano-Reggiano system and little faith in their own ability to survive. Even so, there are a few not unimportant variations that put these apparent similarities in a different perspective. The first observation we must make is that more than 50 percent of these farmers consider themselves to be 'normal'. Some classified themselves as progressive and even as leading examples of their kind. The second observation is that these farmers are experiencing rising levels of worry and stress. The most important problem identified was the cost of labour. This has little or nothing to do with these farms because they rely almost exclusively on the labour of family members and these do not receive a formal wage packet. There is no doubt that the reason for this concern is a low level of self-esteem. To put it more simply, these farmers end up thinking about their problems from someone else's point of view. Other development models form the point of reference for these marginal farmers. Therefore, they have little or no confidence in themselves as a model and, because of this, they even seek to change their own identity. They do not define themselves as small, although this is in fact what they are. Only those who have real pride in their own condition are unembarrassed to define it for what it is - viz an example of small intensive farming. This explanation also helps us understand some of the replies that at first sight appear rather anomalous. The majority of the marginal farmers consider the idea of a livestock farm without matching land resources to be a positive development. Again, they are enthusiastic about the farming patterns adopted by other farmers, if anything, considerably more so than the farmers actually putting such policies into practice. In contrast, they have few cows because they have little land, never having been able to free themselves from these restrictions.

9.3.5 Mountain farms

When the same type of analysis was applied to the mountain farm sample, different farming patterns emerge. However, they had many common elements. As far as the plain farmer is concerned they can be treated as a unique group because their view and strategies have much in common.

All mountain farms have herds that are significantly smaller than the average herd found on farms in the plain and mountain farmers suffer less from work-related mental stress. In managing their businesses, they show less concern for the condition of the Parmigiano-Reggiano market. Other problems are more important including the issue of milk quotas and the quality of the milk and cheese. A possible reason for these differences could be the fact that mountain farmers have a greater loyalty to the Parmigiano-Reggiano production cycle. All the different farming patterns in this area (except for the leading producers) consider the benefits inherent to the Parmigiano-Reggiano system to be a valuable asset, and consider that the differences between Emilian livestock farming and the farming practised on Lombard farms to be positive ones. A further confirmation of the greater adherence to the system can be found in the responses given to the question 'What would you do if there was a repetition of the serious crisis in milk prices?'. Hardly any of the replies consider the possibility of opting for industrial milk production, the marginal and small, intensive farms would rather close down altogether. Farmers in the mountain areas do not see producing industrial milk as an alternative to producing milk for Parmigiano-Reggiano.

So far as the structure of dairy farming in the future is concerned, mountain farmers predict that the family farms will survive. This opinion is shared by all, but it is particularly well-supported by small, intensive and larger, extensive farmers. Some farmers are prepared to accept that farms with a salaried work force could become the dominant form at the expense of the family farm. Nobody believes that only farms with 30 cows have a future, rather it is considered more likely that they will establish links with farms with herds of 80 cows. In the mountains too, there is still room to improve milk production per cow. The great majority of farmers interviewed believe that after the year 2000 average milk production per cow will be around 7,000 kilo.

Looking at the opinions expressed as a whole, the differences that were apparent among the various farms on the plain are also apparent in the mountains. There is one clear distinction however – mountain farmers are more tied to the Parmigiano-Reggiano production cycle than the farmers on the plain. In these areas, disadvantaged as they are by the restrictions

imposed by topology, alternative markets for the milk produced are so unprofitable that they are not even considered.

9.4 Cheese dairies

9.4.1 Introduction

In his theory of the value chain Porter (1985) stresses the importance of how each firm relates its own value chain with the value chain of up - and down-stream firms in the product chain. To what extent does it become convenient to produce the product within the own firm and under what circumstances does it become necessary to delegate functions outside the firm? This question of *make* or *buy* is crucial for the economic efficiency of the firm. Full vertical integration creates the advantage of not having to depend on the power of delivering firms and to internalise the transaction costs related to the bargaining process with these firms. On the other hand vertical integration creates internal bureaucratic costs inherent to the adjustment of different production functions within the firm. Hence the decision to integrate with up- or down-stream firms depends upon the balance between transaction costs and internal organisational costs. Frequently it is more efficient to arrive at certain forms of vertical co-ordination. This ultimately depends on the nature of the contractual relationships the firm is able to create with other firms.

Porter distinguishes cost reduction, product differentiation or focalisation as the firm's main driving force in maintaining a competitive market position. These three basic firm strategies have important consequences for how the different determinants of cost can be combined in a consistent way. Product differentiation definitely incurs costs and these have to be compensated by a better valorisation of the products on the market. The strategy of focalisation increases firm costs still further and puts even higher conditions to the final selling price. The concepts developed by Porter can thus be considered as highly valuable in analysing the behaviour of firms inserted in different product chains.

The question of the extent to which the value chains of vertically co-operating firms are integrated makes the firm's boundary less defined. In neo-institutional theory, the firm as an entity of research has even been abandoned. The economic world is composed of organisations and markets. As has been stated above, what is important here is the question of how to produce: in one, single, vertically integrated organisation or in a series of vertically co-ordinated organisations. As Favereau (1989) pointed

out the interactions of individuals within an organisation are co-ordinated by rules complemented by prices, whilst the interaction on markets between actors are co-ordinated principally by prices and complemented by rules.

In this part of the study an analysis is presented of how the cheese dairies operating in the Parmigiano-Reggiano production system deal with their up-stream and down- stream relationships. The interaction between the cheese dairies and the wholesaler-ripeners and between the cheese-makers and the dairy farmers are also examined. The interactions that contribute to the definition of cheese quality and the written and unwritten rules that govern up- and down-stream relationships are also discussed.

9.4.2 Cheese dairy survey

In 1998, there were 612 cheese dairies operating in the Parmigiano-Reggiano cheese producing area: 491 were co-operatives; 78 were privately owned and 43 were being run as farm-scale cheese dairies.

Co-operative dairies are the largest category of dairies in the Parmigiano-Reggiano area. About 85 percent of the milk used to produce Parmigiano-Reggiano cheese was processed in this type of dairy. The general objective of the co-operatives differ significantly from the privately owned undertakings. First, all members are obliged to supply all their milk to the dairy. Implicitly, the main objective of the co-operative dairy is to maximise the payment made for the milk supplied. When the annual accounts are being drawn up, this objective is paramount. All other secondary objectives are subsumed in this primary goal.

Evidently, within the co-operative, dairy farmers are fully integrated into the cheese dairies, or in other words the value chains of both firm types are completely integrated. In the co-operative the up-stream relationships are governed mainly by the written and unwritten rules that govern the interaction between the two entities.
The improvement of cheese quality is obviously an aim of all cheese dairies, but the very concept of quality has widely different connotations. The final quality of the consignments of cheese from the dairies depends largely on the interaction between the cheese-maker and the supplying members, on the cheese-maker's skills and on the quality characteristics of the milk supplied. The strategies adopted by the cheese dairies may be very different depending on the size of the dairy and the degree of integration in the post-production stage: the extent to which the dairy undertakes the ripening of the cheese itself.

A study involving 115 dairies has been conducted in order to identify their strategies and their relations both with their farmer members and those who buy their products. The sample was selected as being representative of the situation prevailing within co-operative cheese dairies in the Parmigiano-Reggiano production area. The sample represents 22 percent of co-operative dairies and 18 percent of all dairies within the cheese area producing 18 percent of the milk processed in the entire Parmigiano-Reggiano production area. The cheese-makers and chairmen of these dairies were interviewed using a structured questionnaire.

Table 9.4 The research sample of cheese dairies

	Plain		Mountain		Total	
	n.	%	n.	%	n.	%
Mantua	9	12.8			9	7.8
Parma	20	28.5	15	31.1	35	30.4
Reggio Emilia	20	28.5	13	28.9	33	28.7
Modena	21	30	17	38.8	38	33
Total	70	100	45	100	115	100

Most cheese dairies sell their consignments of cheese to the wholesaler-ripener after it has been ripened for about seven months. The statistics produced by the sample indicate that 77 percent of the co-operative dairies sell their cheese after it has ripened for this amount of time. Only 23 percent ripen their cheese for between 18 and 24 months, at which point the cheese is ready for consumption. It is not very common for dairies to be very active in this final ripening stage. Given the fact that the average size of these cheese-dairies (processing of 3,330 metric tons a year) is higher than average, it is worth noting that they process 29 percent of the milk in the Parmigiano-Reggiano area.

In the present survey dairies have been broken down into the following categories: small, medium-sized and large dairies (all acting autonomously) and 'integrated' dairies – that are active in the ripening process and produce Parmigiano-Reggiano cheese ready for consumption. Table 9.5 lists the main structural characteristics of the four categories of cheese dairies.

Table 9.5 Some structural characteristics of the cheese dairies in the sample

	Number	% Dairies	% milk processed	Milk processed per year (tons)	Average number of members
Small	24	20.9	8,9	1,108	10
Medium	47	40.9	32	2,041	15
Large	18	15.7	30,3	5,047	21
Integrated	26	22.7	29	3,330	17
Total sample	115	100	100	2,608	15

Two actors play key roles within the co-operative cheese dairy structure: the cheese-maker and the chairman of the co-operative. The first is responsible for the quality of the cheese produced, whereas the second, together with the management committee, carries out commercial functions. The chairman maintains financial relations with the co-operative members supplying the milk and with the cheese buyers. The questionnaire distributed for this survey included a number of questions that had to be answered by the cheese-maker and another section contained questions for the chairmen.

For a full understanding of the various strategies adopted by the co-operative dairies in their attempts to increase the return on the milk they receive from their supplier members, it is important to emphasise that there is little room for product diversification. The majority of cheese dairies only sell Parmigiano-Reggiano and its average age is between six and seven months - in other words it is ready for direct consumption. Hence the cheese dairies are not in direct contact with the end consumer. Their contacts are with a secondary demand that originates from the wholesaler-ripeners. The majority of cheese dairies do not know the final sales outlets that sell their product. Only those dairies undertaking the final ripening process are better informed in relation to the final destination of the cheese they produce, because they contract directly with retailing businesses or sell directly to the end consumer.

Table 9.6 Do you know the final sales outlet your cheese is sold through? (N= 115)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Unknown	46.2	58.3	63.8	77.8	60.9
Supermarkets	19.2.	20.8	14.9	16.7	17.4
Small Retailers	34.6	20.9	21.3	5.6	21.7

Long- and short- term trends in final consumption patterns are registered by the cheese ripening firms. They are not restricted to purchasing cheese

from a single cheese dairy and can thus meet changes in final demand by purchasing cheese from a range of different cheese dairies, each being characterised by its own specific quality of unripened cheese. Hence the strategy involving product diversification is available mainly to the ripening firms and is only a very marginal option for the cheese dairies.

Basically the dairy has three options in pursuing its objective of maximising return on its members' milk:

- the reduction of waste production;
- reduction of processing costs;
- increasing the quality of the unripened cheese in order to achieve a higher price;
- increasing the business skills and sales strategy of the co-operative chairman.

A strategy based on producing a range of different quality types of unripened cheese would be too costly for an individual cheese dairy. The additional costs could not be recouped by charging higher prices. Quality differentiation, if any, can be seen at a more general level taking all dairies as a whole, but it is not apparent at the level of the individual cheese dairy.

Obviously, all cheese dairies seek to improve their cheese quality. The end result, in the form of the total cheese production for sale, depends to a significant extent on the interaction between the cheese maker and the milk-supplying members, on the cheese-maker's skills and on the quality characteristics of the milk supplied.

Notwithstanding the distinction made here between 'integrated' and 'non-integrated' dairies, so-called non-integrated dairies do complete the ripening process for a limited part of their production. Almost all dairies have a sales outlet for the direct sale of fully ripened cheese. The integrated dairies, however, ripen their entire cheese production and sell cheese that is ready for consumption to wholesalers, retailers and large-scale sales distribution networks.

The strategies of the four groups of cheese dairies have been analysed in terms of the following issues:

1 Management of demand and relations with the purchasers.
2 Management of the production process.
3 Training of the work-force.
4 Management of the supply and relations with their farmer members.

9.4.2.1 Relations with the purchasers of the cheese

Almost 90 percent of cheese produced by the non-integrated dairies is purchased by the wholesale cheese ripeners in consignments made up of a full year's production with an average ripening age of seven months. The specialist ripeners will thus be responsible for completing the ripening process.

Only the large dairies are in a position to enter into contacts with sales distribution networks and retailers, but within the non-integrated group even though this is to a very limited extent and involves some 10 percent of production. This remains true even though they have made the decision not to ripen their entire year's consignment of cheese. The portion of cheese production ripened by the dairies themselves is sold to retailers (3.4 percent), hypermarkets (5.9 percent) or directly to the consumer (2.1 percent).

Table 9.7 Sales outlets used (percent) (N= 115)

	Integrated	Small	Medium-sized	Large	Total
Wholesalers-ripeners	73.9	92.6	96.8	88.6	89.7
Retailers	6.0	.0	.0	3.4	1.8
Hypermarkets	1.3	.0	.0	5.9	1.2
Final Consumers	18.8	7.4	3.2	2.1	7.3
Total	100.0	100.0	100.0	100.0	100.0

Those cheese dairies have invested in a ripening storehouse and manage the entire production process and they have a more diverse client group. A large proportion of the production from cheese dairies that integrate the final production stage is sold directly to consumer (18.8 percent). The integration with others in the ripening stage allows these dairies to have more frequent contact with the end consumer than those who have not undertaken such integration. The chairmen of these dairies have more information about sales outlets for final consumption (see Table 9.7). They justify the decision to undertake their own ripening because they are convinced that this strategy ensures a greater income for the dairy's members (88 percent).

It is nevertheless surprising that the integrated cheese dairies still sell over 70 percent of their ripened cheese to wholesalers. This means that these dairies only reach the final outlet to a very limited extent. Presumably the quantities sold by these dairies are too small to provoke the interest of the large-scale retail sector.

Table 9.8 Does ripening the cheese yourself ensure a greater income for the members?

	Integrated %	Small %	Medium-sized %	Large %	Total %
No	12.0	25.0	30.4	50.0	28.0
Yes	88.0	75.0	69.6	50.0	71.9

The chairmen of large dairies that are uninvolved in integrated production are those least convinced of the financial benefits that can be derived from investment in the ripening stage (50 percent). The majority believe (87 percent) that dealings with large cheese wholesaler-ripeners are more likely to be good for the dairy's business and it is thus better to pass on the ripening activity to others (Table 9.9). The choice made by the large dairies to ripen ten percent of their production for sale to the distribution network may be motivated by a limited diversification strategy. This does not, however, impinging on their dominant strategy of not undertaking the ripening process themselves.

Table 9.9 What kind of purchaser do you prefer as being good for your business?

	Integrated %	Small %	Medium-sized %	Large %	Total %
Retailer	36.0	15.0	21.7	6.3	21.5
Small ripener	24.0	35.0	19.6	6.3	21.5
Wholesaler	40.0	50.0	58.7	87.5	57.0

It is surprising to note the limited number of wholesalers contacted before the supply contract is signed. A large majority of dairies only contact one cheese ripener and their clientele is also fairly stable over time (76 percent). Very often (in 77 percent of cases) the entire year's production is sold to a single cheese ripener. In the case of the small dairies it is almost always one ripener who purchases the entire production. Even the large dairies, however, do not have a very diversified portfolio of commercial contacts. Almost 60 percent of cheese is sold to one client and 30 percent to two clients. Those dairies undertaking the entire ripening process are clearly closer to the final consumer and their client group as a result is more diversified. More than 20 percent of these dairies sell their production to more than three clients. On the other hand, it is still worth noting that even among these dairies 58 percent had only one client.

Table 9.10 Normally, how many firms do you contact before signing the contract? (N=112)

	Integrated %	Small %	Medium-sized %	Large %	Total %
1	54.2	79.2	84.8	76.5	75.7
2	16.7	12.5	10.9	11.8	12.6
More than 2	29.2	8.3	4.3	11.8	11.7

Table 9.11 Over the past year, who has bought your cheese? (N= 112)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Single client	58.3	95.8	83.0	58.8	76.8
2 clients	12.5	4.2	12.8	29.4	13.4
3 clients	8.3		4.3	5.9	4.5
More than 3 clients	21.0			5.9	5.4

Apart from the fact that the dairies only sell to a small number of purchasers, it was also clear that the clientele remained very stable over time. The majority of dairies do not change their outlets very often. Year after year the entire cheese production is sold to the same ripeners or wholesalers. This observation is valid for all dairies, but is particularly true for large and integrated dairies.

Table 9.12 Describe the nature of sales effected over the last five years. (n= 111)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Stable	87.5	60.9	68.1	76.5	72.1
Changed: 2 purchasers	21.7	17.0	11.8	13.5	
Changed: more than 2 purchasers	12.5	17.4	14.9	11.8	14.4

Two facts emerge from these data:

- cheese dairies attempt to establish long-term trust relationships with the purchasers of their cheese;
- dairies have a low bargaining power.

The dairies have little bargaining power when dealing with the cheese wholesaler-ripeners because they neither seek nor are able to sell to the highest bidder. On the other hand, however, the stability of their relationship with a few purchasers ensures that they have both a secure and steady outlet for their production. This means that the payments they make for the milk supplied to them are also secure. Sales stability over time to a few purchasers guarantees a high level of reliability in

commercial relationships and payment conditions are respected. All this contributes to a reduction in transaction costs.

The ripeners are often in an advantageous position in their dealings with the cheese dairies. The cheese dairies are constrained by the demand for liquidity from their member farmers and by the limited amount of space available for ripening cheese, therefore they cannot afford to wait too long before selling their unripened cheese production. On the other hand, in order to increase their return on capital operating in two adjacent markets subjected to wide price fluctuations, the ripeners have to:

- choose the right moment to buy the consignments of cheese;
- take great care in choosing the right cheese-dairies to reduce the risk of waste production to a minimum during the long ripening process;
- obtain the best buying terms possible from the cheese dairies, delaying the time for the weighing, the collection and the payment for the product.

The wholesaler needs an extensive knowledge of the market to be able to choose the best time and the best conditions for purchasing the cheese. A number of studies carried out on the Parmigiano-Reggiano market have concluded that it is characterized by a certain degree of oligopsony. This means that the ripeners have greater bargaining power than the cheese dairies (Messori 1994). In its sales strategy the cheese dairy has a limited amount of room for manoeuvre, but this does not mean that there is no room at all. Half the chairmen of the large cheese dairies interviewed believe that the skills of the chairman in obtaining advantageous price terms counts as much as the quality of the cheese produced. The chairmen of the integrated dairies, consistent with the diversification rationale, believe that, with respect to other dairies, their role is of particular importance in the pre-contractual bargaining process. These dairies therefore have a little bit more room for bargaining.

Table 9.13 Are the chairman's commercial bargaining skills at least as important as the quality of the product in obtaining advantageous price terms? (N=114)

	Integrated %	Small %	Medium-sized %	Large %	Total %
No	34.6	50.0	46.8	47.1	44.7
Don't know	3.8	4.2	4.3	5.9	4.4
Yes	61.5	45.8	48.9	47.1	50.9

9.4.2.2 Management of the production process

The degree of craftsmanship involved in the cheese-maker's work is very high and involves all the critical aspects of the production process. Furthermore, since each farmer supplies milk with different qualitative

characteristics and this quality changes from day to day and from season to season, the work of the cheese-maker does not lend itself easily to automation. The cheese-maker's work requires a high degree of skill because it involves the processing of raw material and in this case it is a raw material that can vary considerably in time and space.

The importance of the cheese-maker's work is brought into sharp relief when we consider almost 50 percent of the chairmen of large cheese dairies assert that the cheese-maker's skills have the greatest effect on the end quality of the cheese. This comes before the intrinsic quality of the milk measured in terms of hygiene and casein. While the chairmen of the small dairies do not under-estimate the cheese-maker's role, they believe that the basis of a good cheese lies primarily in its casein.

Table 9.14 Which are the most important factors in making a better cheese quality?(N=115)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Casein	32.0	54.2	32.5	17.6	34.9
Hygiene	36.0	20.8	40.0	35.3	34.0
Cheese-maker	32.0	25.0	27.5	47.1	31.1

The cheese-maker has to follow a long apprenticeship in order to acquire sufficient technical skill. In general, there are many years of apprenticeship before it is possible to become a fully-fledged cheese-maker. The sample data suggest that an average apprenticeship takes about eight years. The first step after completing an apprenticeship is to become a cheese-maker in a small dairy. Wages are relatively low because small dairies cannot afford high labour costs. After acquiring some experience the cheese-maker will move on to a large dairy. A cheese-maker in a large dairy will worked for about 28 years. Nine years will have been apprenticeship and 19 will be spent as a cheese-maker. The average career-length for the small dairy cheese-maker is about 19 years.

Table 9.15 Data on the cheese-maker's working career (N= 115)

	Integrated	Small	Medium-sized	Large	Total
Years as cheese-maker	17	12	15	19	16
Years as Apprentice	8	7	9	9	8
Cheese-maker's total Working life	25	19	24	28	24

It is clear that milk quality has undergone significant changes over time. The majority of cheese-makers assert that 20 years ago it was easier to

make cheese than it is today. This belief reflects the substantial changes that have affected dairy cattle both in terms of genetics and feeding practices. The absence of reward for milk quality, a situation that has been going on for decades, has resulted in a dramatic decline in the casein content of milk. However, even more important has been the replacement of traditional breeds, firstly with the Dutch Friesian and then with the American and Canadian Holsteins. This has altered the composition of the casein and reduced the frequency of the kBB variants that have a beneficial effect on the speed and consistency of milk coagulation.

Table 9.16 From a professional point of view, was it easier to make Parmigiano-Reggiano twenty years ago than it is now? (N=114)

	Integrated %	Small %	Medium-sized %	Large %	Total %
No change	24.0	33.3	23.4	11.1	23.7
Now easier	40.0	12.5	23.4	27.8	25.4
20 years ago easier	36.0	54.2	53.2	61.1	50.9

The milk may be processed in the vats in three different ways:

1 By processing the milk from each farmer in a separate vat.
2 By putting the milk from the small farmers together and keeping it separated from the milk provided by larger farmers.
3 By making a single mix of all milk supplied to the dairy.

The traditional method involved separating milk according to its origin. This is the only way the cheese-maker is able to identify a direct correlation between the different qualities of cheese and the different milk supplies. This is done by marking the cheeses with the code number of the farmer supplying the milk used in the making of a particular cheese. If there are anomalies in cheese quality, the cheese-maker is able to trace it back to a particular milk supplier. This method allows the cheese-maker to carry out quality control checks on the production cycle.

In spite of the undeniable benefits of this system, over the last few years it has become increasingly common to mix all the milk together in the vats without any regard to its farm of origin. It is a technique that results in a standardisation of the final quality of the cheese and an increasing homogeneity of the overall production. This practice has undoubtedly grown up in response to market demand as articulated by large-scale distributors. They ask for a good quality product, but consistency over time is even more important to them.

Table 9.17 What is the criterion you use when putting the milk from different farms into the cheese vats? (N=114)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Separate Farms	24.0	45.8	38.3	50.0	38.6
Large on their own	60.0	20.8	27.7	5.6	29.8
Small together and Large together		8.3	2.1	5.6	3.5
A single mix	16.0	25.0	31.9	38.9	28.1

Even though it is a practice that involves only a minority of cheese-dairies, sample statistics show that it is mainly cheese-makers in the large cheese dairies that use the single mix method when processing milk. This is because the large dairies sell their product to large-scale ripeners who in turn sell into a large-scale distribution network. The majority of cheese-makers in the small cheese dairies still process the milk separately in the different vats and seek to exploit the variety of milk quality coming from the different herds. Their objective is to produce the highest possible quality. This way of working allows those kinds of milk that, when combined with others tend to produce qualitatively less than perfect cheese, to be separated into different vats. When all the milk is mixed together in a single mix irrespective of its origin it is unlikely to produce the very highest quality cheese. The product may well be of good quality, but the main reason for using this method is to keep variability to a minimum. This tends to be at the expense of the highest quality.

Another way of increasing the standardisation of milk quality is by using dry forage crops throughout the year. Traditionally farmers give green summer forage to their herds from spring to autumn. This is cut and brought to the cow-shed each day. The practice reduces any loss of dry matter during harvesting because losses inherent in the hay-making process are avoided. At the same time, the change from winter rations (based on hay) to green forage can provoke mastitis in high production cows. Another effect of feeding with green forage is that the milk, and thus the cheese, becomes more yellow because of the higher concentrations of carotin. The cheeses made in the summer are yellow in colour while those in the winter are whiter.

The introduction of the hay-only feeding system and the elimination of green forage has the following advantages:

1 Fewer problems caused by mastitis in high production herds;
2 Cheese production is more homogeneous so far as colour is concerned, a fact that is increasingly appreciated by the large retail sector.

Table 9.18 What forage do you advise your farmers to use? (N= 114)

	Integrated %	Small %	Medium-sized %	Large %	Total %
All dry forage	85.0	82.6	79.5	76.5	80.8
Green forage in summer	15.0	17.4	20.5	23.5	19.2

In response to the question 'What feed do you advise your farmers to use?' 80 percent of the cheese-makers answered that they prefer dry forage. The cheese-makers in general would prefer dry forage to be given in summer because it makes milk processing easier. Cheese-makers from all the different types of dairies shared this opinion.

If the age of the cheese-maker is taken into account, however, there is a greater difference in the types of replies received to the question. The older cheese-makers generally advise feeding green forage in the summer. These cheese-makers have sufficient experience to be able to deal with a milk quality that varies considerably over time. The milk quality changes significantly as soon as green feed is introduced in the Spring. These changes can be dealt with more easily by older cheese-makers.

Table 9.19 What feed do you advise your farmers to use? (N=113)

	Up to 35 Years %	From 36 to 45 years %	From 46 to 55 years %	Over 55 Years %	Total %
All dry forage	88.2	84.6	68.0	57.1	75.8
Green in Summer	11.8	15.4	32.0	42.9	24.2

9.4.2.3 Management of relations with the farmers

The co-operative dairies producing Parmigiano-Reggiano have, on average, about 15 farmer members. This number can vary from 9 to 50 in some of the larger co-operative dairies.

The sample statistics show that the average size of the farms that supply milk is in direct correlation to the size of the dairy. The large dairies receive milk from the large herds and the small dairies from the smaller herds.

Table 9.20 Farm sizes of the supplying members (N= 115)

	Integrated	Small	Medium-sized	Large	Total
Number of suppliers	17	10	15	21	15
Average annual Supply in litres	219,600	135,100	166,800	273,200	186,400

Milk and cheese production is fully integrated within co-operative cheese dairies. The dairy farmers own the dairy. The chairman is always a farmer and is elected by a general assembly of members. The cheese-maker is paid by the farmers and is their employee.

The nature of the relationship between the dairy farmers and the cheese-maker has a decisive impact on the quality of the cheese. On the one hand, farmers can dismiss a cheese-maker if there is an increase in waste production and on the other the cheese-maker can keep a check on any changes in the quality of the milk coming from members. He warns those producers whose milk falls short of the required standard too often. The relationship between the farmers and the cheese-makers can change depending on the quality of the milk.

The milk quality in turn not only varies from herd to herd but also over time. This can be seen in the seasonal variations in milk quality resulting from changes in feeding regimes. It also occurs as a result of the introduction of new production practices. The following are of particular importance in this respect:

- Development through genetic selection.
- Introduction of unifeed system.[2]
- Feeding of dry forage in summer.

These changes mean that the cheese-maker must be able to adjust cheese-making techniques to cope with changes in milk quality – a skill not possessed by all cheese-makers. An absence of such skills may lead to his dismissal. On the other hand, the cheese-maker may advise the farmer members to change the feed regime or their milk production methods so long as the recommendations fall within the production regulations. The feeding of silage to young heifers is allowed under Parmigiano-Reggiano regulations, but the presence of silage in the cowshed may have indirect and undesirable effects on the milk and have negative repercussions on the quality of the cheese. A second problem is connected to genetic selection. A genetic improvement that is primarily directed at milk quantity per cow may be effected at the expense of the casein content of the milk. The reduction of casein leads to a reduction in the 'strength' of the milk and hence there will be a lower cheese yield from the same quantity of milk. The milk quality payment system applied by almost all dairies serves to correct too much emphasis on performance-based criteria in genetic development. However, financial incentives may not be enough on their own. In such circumstances the cheese-maker is able to take action against individual farmers in order to ensure that they orientate genetic selection more towards the quality of the milk produced and less towards quantity.

In short, the relationship between the dairy farmers and the cheese-maker is governed on the one hand by written rules such as the statute of the co-operative and the milk quality payment schemes, and on the other by an interactive process of negotiation between dairy farmers and the cheese-makers. This process is particularly important in determining the final quality of the cheese. The power relationship between cheese-makers and dairy farms has changed significantly over time. If, in the past, cheese-makers commanded dairy farmers, nowadays they have become increasingly dependent on the decisions taken by farmers.[3]

Table 9.21 Is it better to have many or few suppliers of the same amount of milk? (N=114)

	Integrated %	Small %	Medium-sized %	Large %	Total %
No difference	8.3	8.7	6.7	11.1	8.2
Few	91.7	87.0	88.9	83.3	88.2
Many		4.3	4.4	5.6	3.6

The majority of cheese-makers prefer to deal with just a few farmers. A less changeable milk supply makes it easier to process milk into Parmigiano-Reggiano. It has already been noted that the majority of cheese-makers believe that it was easier to process milk into cheese twenty years ago than it is today. Milk is now more difficult to process because it comes from non- traditional breeds having high yields per cow. In such a context it is understandable that today's cheese-makers prefer to have a small number of suppliers because this removes a factor of variability in milk quality. The majority of cheese-makers state that dairies that have a limited number of suppliers produce higher quality cheese. This is consistent with this view.

Table 9.22 What quality of cheese is produced by a dairy with few suppliers, all else being equal? (N=110)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Better	60.9	58.3	68.9	55.6	62.7
No difference	39.1	41.7	28.9	33.3	34.5
Worse			2.2	11.1	2.7

9.4.2.4 Types of cheese dairies and quality of the cheese

As has been clearly demonstrated, a single cheese dairy is not able to adopt a firm diversification strategy. This is because the extra costs involved cannot be compensated by the price differential for a variety of different product types. In their search for the maximum return price on

the milk, all dairies concentrate on reducing the cost of processing the milk into a particular and uniform quality grade of cheese over the entire production. It is then the cheese wholesalers and ripeners who apply a strategy of diversification by combining the different cheese qualities produced in the individual dairies. In this way they can ensure that they have a wide range of Parmigiano-Reggiano available for sale. But which dairies produce better quality cheese?

Table 9.23 What quality of cheese does a mountain cheese dairy produce, all else being equal? (N=110)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Better	47.8	75.0	71.1	55.6	64.5
No difference	52.2	25.0	22.2	44.4	32.7
Worse			6.7		2.7

The majority of cheese makers are convinced that cheese produced by mountain cheese dairies is superior in quality. Only the responses from integrated and larger dairies tend to suggest otherwise. The mountain dairies seek to recover their processing costs by focusing on the quality of their production. Their processing costs are higher on average because of the greater expense involved in collecting the milk.

Table 9.24 What quality of cheese does a dairy produce which is supplied by large dairy farms, all else being equal? (N=110)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Better	45.8	12.5	40.0	72.2	40.5
No difference	45.8	50.0	40.0	22.2	40.5
Worse	8.3	37.5	20.0	5.6	18.9

The above table indicates a significant split in opinions about the quality of cheese produced by dairies supplied with milk from the large farms. The cheese-makers in the large dairies - the prime recipients of milk from this kind of farm - claim that their cheese quality is better than average. The small dairies are by no means convinced that this is true. Replies received from medium-sized and integrated dairies indicate a mid-way position.

Table 9.25 What kind of cheese quality does a privately run dairy produce, all else being equal? (N=110)

	Integrated %	Small %	Medium-sized %	Large %	Total %
Better	4.5	12.5	13.6	12.5	11.3
No difference	50.0	50.0	34.1	50.0	43.4
Worse	45.5	37.5	52.3	37.5	45.3

The last question in this series concerned the quality of cheese produced by the privately run dairies. Almost no one considered this kind of dairy capable of producing an above-average quality cheese. The replies from the cheese-makers are essentially divided between 'no difference' and 'worse'. All types of co-operative dairies are in almost complete agreement that privately-run cheese dairies produce cheese that is less good in quality and is certainly no better than the cheese produced in co-operative dairies.

This survey of different assessments of cheese quality produced a complex variety of answers. There is a general belief that the type of dairy does effect the quality of cheese. So far as mountain cheese dairies are concerned, almost all cheese-makers from almost all kinds of dairy agreed that they produce better quality cheese. Some characteristics denoting quality may be considered entirely objective. However, the split in opinion both between small and large cheese-dairies and between integrated and non-integrated led one to the conclusion that the assessment of quality may also be a very subjective process. By taking economic criteria as a measure it may be possible to find out which qualities are recognised by the market. The price difference between mountain and plain dairies proves in fact the higher quality of the former product.

9.4.2.4 Short discussion of cheese dairy survey

According to the neo-classical theory, a market is most efficient when goods are neither over- or under-priced, or in other words, when prices are set on the basis of expected returns. An efficient market is characterized by the greatest possible openness, with instantaneous access to information on prices and stock levels. These data must be provided to all potential participants in the bargaining process. According to the market analyses carried out by Rosa (1985), the Parmigiano-Reggiano market – in neo-classical terms – is inefficient. This is because both small- and medium-sized operators find it difficult to access relevant data. An indication of this low level of efficiency is the fact that the operators rely on past experience alone when it comes to setting prices. At the moment

when purchase occurs they are not fully informed about current and actual demand.

Nevertheless, it appears that large scale-ripeners, with substantial cheese storage facilities, are able to realize additional profits solely because of their superior knowledge of market conditions. This has been the stimulus for setting up a market observatory to increase market transparency. This has been an initiative of the Consortium, the cheese dairies representative body.

The Parmigiano-Reggiano market is characterised by a high degree of uncertainty and the economic behaviour of the actors in the supply chain is one of bounded rationality. Margins in cheese production and in cheese ripening vary considerably from year to year. Cheese dairies are confronted by opportunistic behaviour on the part of cheese ripening firms. Only a few cheese dairies are involved in the process of ripening cheese because of the high financial risks involved in this activity.

The cheese dairy survey provides a view of how dairies deal with uncertainty on the market and the opportunism in commercial relationship with ripening firms. First the upstream relationships with the farmers are governed by a complete vertical integration through a co-operative organisation. The majority of dairies are co-operatives and therefore the upstream relationships change very little. As far as the private dairies are concerned several open interviews provided evidence that there was a stable relation with dairy farms. As private dairies are in a minority, their chances of changing their reservoir of milk-delivering dairy farms are limited. They are in a certain sense locked in the co-operative structure. Although they remain private, these firms are almost forced to imitate the co-operative organisation.

Essentially most cheese dairies have very stable commercial relations with the firms involved in ripening the cheese. It is through these stable relationships that cheese dairies reduce their transaction costs. Always selling cheese to one or two cheese ripeners does not necessarily give the highest return on the resources employed, but it reduces the risk of being left with large stocks of unsold cheese or to be paid at a disadvantageous rate. It is this trust relationship with solves part of the problem related to the uncertainties and opportunism that characterise the market for Parmigiano-Reggiano cheese.

The decision to ripen cheese themselves does give some room for a limited diversification strategy. The number of clients is enlarged and more knowledge is obtained about the evolution of the nature of the final

demand. Nevertheless, the financial risks involved explain why only a limited number of cheese dairies become involved in cheese ripening. New market uncertainties are added to existing ones, and milk payments to the dairy farmers are delayed.

Finally, the consequences of changes in demand are transmitted by wholesaler-ripeners to the cheese dairies. The large retail sector asks for a more standardised product thus putting the techniques of production under pressure. When more and more cheese is sold through these channels, changes in milk processing techniques will eliminate the highest cheese qualities on the market. Only those cheese dairies that are able to sell to small niche markets, speciality shops and via direct sales will continue to process milk from individual dairy farms separately.

9.5 Cheese maturing firms and wholesalers

The above analysis of responses obtained from cheese dairies indicate that the majority of dairies do not finish the maturing process of the cheese themselves. This is because these dairies have inadequate structural and financial resources. The cheese-maturing businesses are primarily concerned with this delicate phase of the production cycle. It is an activity that requires very specific technical and commercial skills, and for that reason the majority of these businesses are specialists in the sector. The production structure of these companies has been described in Paragraph 6.3.3.

Very often, the businesses involved in this sector have had considerable experience with maturing cheese. Since these maturers bring the cheese to the stage when it is ready for consumption, they are almost always involved in the marketing of the cheese and act as cheese wholesalers. The wholesaler-maturers' primary concern is to maximise the return on capital invested. The Parmigiano-Reggiano market is strongly cyclical in nature with marked price fluctuations both in the wholesale and retail sectors. The maturer's business is caught between these two markets and the risk of financial failure is fairly high. A second, no less important objective is thus simply to ensure that the business survives.

9.5.1 Management of the productive process

The maturing of the cheese requires a high level of specific technical skills since it is a delicate and long process. It also involves proteolytic changes of importance to the final organoleptic quality of the product. The majority of businesses involved in the maturing of cheeses have modern

premises with an air-conditioned plant at their disposal. The average starting age of the maturing cheese is between six and seven months and it is matured at least till it reaches the minimum age of 18 months. The process often continues until the cheese is two years old.

Table 9.26 Technical and Hygrometric conditions of Cheese Store-houses.

	Temperature °C			Optimal Humidity
	Average	Minim.	Maxim.	optimal relative hum.%
Store House 10-12 months	20	12	22	Summer 80-85 Winter 75-80
Store House 1-2 years	18	12	18	80-65

Source: Parmigiano-Reggiano. The Consortium's three-monthly journal.

The table illustrates the optimum conditions for the maturing of cheese. Throughout the process salt must be introduced into the cheeses in a homogeneous way and the water content of the cheeses must also be reduced. As a result the cheese undergoes a significant weight loss – and this reduction in weight is one of the risks inherent in the maturing process. The majority of cheese-maturing businesses conduct the maturing process in their own storehouses. Some, however, contract it out to third parties. The local banking sector is involved in the contracting out process. Those who make use of such services can get loans at normal rates of interest using the cheese as security. The nature of the loans given by the banks depends on:

- the value of the cheese;
- market risks;
- the forecast of market trends.

The level of financing does not exceed the value of two thirds of the cheese pledged as security. The maturers pay for the cost of maturing, while the banks receive interest payments and the consignment of cheese acts as their security.

9.5.2 Management of demand

Parmigiano-Reggiano cheese is primarily used as a condiment to first course dishes that are based on pasta or clear soups. This means that the possibilities for market diversification or sub-division is extremely limited. A cheese must be at least 18 months old before it can be grated satisfactorily. Less mature cheeses are not suitable. Attempts to introduce a not yet matured form of Parmigiano-Reggiano onto the market as a table cheese has not been particularly successful. In this form the cheese had a very limited use. One important problem faced by young Parmigiano-

Reggiano cheese is its quality. The potential demand has been met with a supply of doubtful quality. Young Parmigiano-Reggiano is seen by the consumer as a second rate cheese (Torelli 1995) and not easy to distinguish form its competitor on the market the often younger Grana Padano. It is only at advanced stage of ripening that Parmigiano-Reggiano expresses its superior quality.

In spite of the considerable limitations to product diversification as far as the level of maturity is concerned, there have been various attempts to introduce technological innovation in the sector. Mostly these have involved the packaging or treatment of the product. The first step towards diversification was the production of *vacuum packed* spikes or points. This method of sale was taken up by many businesses in response to the needs of the large-scale distribution sector. In the first few years this kind of pre-packed Parmigiano-Reggiano was sold in one kilo portions. As the number of one or two person households increased, portions of 300 to 400 grams become more common. Today, all supermarkets offer the product in this form and require maturers to deliver it to them already packed. By 1995 this pre-wrapped form had a market share of 21.5 percent of total sales.

Table 9.27 Division of Grana cheese sales by manner of presentation

	1992	1994	1995
Whole Cheeses	7.0	73.0	71.5
Wrapped	18.0	20.5	21.5
Ready cut	1.0	3.5	3.7
Grated	2.0	3.0	3.3
Total	100.0	100.0	100.0

Source: Databank

The second attempt at diversification took the form of grated cheese. This kind of sale is gradually increasing but has not yet managed to exceed 4% of total Parmigiano-Reggiano sales. This limited growth can be attributed to a lack of consumer confidence in the quality of cheese that has been grated. By far the majority of consumers prefer to grate the cheese at home or have it grated at the point of sale (Torelli 1995).

The cheese maturing businesses can be characterised by the following variables:

- the size of the business;
- the degree of diversification in the cheese sector generally;
- diversification in the Parmigiano-Reggiano cheese sector;

Table 9.28 Diversification of Parmigiano-Reggiano cheese sales for the largest firms in the sector

	1990			1995		
	Whole cheeses	Packed cheese	Grated cheese	Whole cheeses	Packed cheese	Grated cheese
1	81,2	18,0	0,8	20,0	80,0	0
3	100,0	0	0	75,0	15,0	10,0
4	n.a.	n.a	n.a	40,0	60,0	
5	n.a.	n.a	n.a.	55,0	40,0	5,0
6	n.a.	n.a	n.a.	50,0	40,0	10,0
7	n.a.	n.a	n.a.	30,0	50,0	20,0
8	n.a.	n.a	n.a.	70,0	25,0	5,0
14	80,4	15,7	3,9	20,0	79,0	1,0
15	0	6,6	89,5	0	20,0	80,0
16	100,0	0	0	88,0	12,0	
17	100,0	0	0	100,0	0	0

Source: Databank

The productive structure of the firms concerned have been illustrated in Paragraph 6.3.3. The results of that analysis demonstrated a significant concentration of market power in the sector - the first four businesses share control of 22 percent of Parmigiano-Reggiano supply. It has been possible to confirm that all the large firms are active in maturing both Parmigiano-Reggiano and Grana Padano, and the largest offer a wide range of different cheeses.

From this overview it becomes clear that some of the largest firms are more involved in the maturing of Grana Padano than Parmigiano-Reggiano. Often these firms are not located within the Parmigiano-Reggiano production area. They are involved in the maturing of Parmigiano-Reggiano cheese too, but primarily because of the need to have a wide and diversified supply of cheese. These firms are less linked to the institutional setting that surrounds the Parmigiano-Reggiano production system, their behaviour is less influenced by the local culture and as a consequence these firms do care much about the risk of a progressive industrialisation and standardisation of the production process.

Table 9.29 Diversification by product of the main PR maturing cheese firms

	Parmigiano-Reggiano	Grana Padano	Other grana	Other cheeses	Butter	Milk and milk derivates	Turnover
Firm n.	%	%	%	%	%	%	billion lire
1	49,7	21,3			29,0		434
2	22,8	9,7				67,5	415
3	320	54,8	4,6	8,6			291
4	70,0	30,0					120
5	38,7	58,0			3,3		150
6	16,9	50,5	16,9	15,7			344
7	13,9	48,8	7,0	30,3			380
8	14,7	51,3	7,3	26,7			300
9	80,0	20,0					48
10	17,1	26,9	4,9	51,0			194
11	7,4	14,4			78,2		380
12	58,0		6,4	35,6			45
13	9,9	26,7		63,4			205
14	20,0	70,0	10,0	0			78,5
15	80,0	20,0		0			16
16	5,8	90,4		3,8			130
17	3,8	72,6		0	23,6		72
Total							

Source: Elaborated on data Databank

Notes

1 In the following analysis the data refer to 1996, the year in which the interviews have taken place. For a series of questions it is important to keep this in mind, in particular when opinions are collected about the future of the PR system in the year 2000. Farm structure has changed considerably between 1996 and 2000, but the differences in farming patterns remained unchanged.
2 The principle of the unifeed system has been discussed in Chapter 8.
3 A comprehensive analysis of the change of the role of the cheese-maker is found in the anthology of Silvio Antonello (1999)

10 Technical and Economic Efficiency

10.1 Introduction

The particular system associated with producing and processing milk for Parmigiano-Reggiano cheese discussed in the previous chapters is bound to a body of regulations designed to maintain its specificity and high quality. This system obviously generates higher costs than the production and processing of industrial milk. When farmers chose to participate in this they must be prepared to accept and sustain a higher labour input and feed their cows with rations that cost more per unit of feed administered. This system can only be economically viable when cheese and milk can be sold for a price high enough to cover these extra costs. The higher labour input involved both on the dairy farms as well as in the cheese dairies is reflected in the extra employment that the Parmigiano-Reggiano system is able to create in comparison with the industrial production system.

The present chapter presents a micro and macro economic evaluation of the Parmigiano-Reggiano system. An analysis is made of the technical and economic efficiency of the dairy farms and the differences between the Parmigiano-Reggiano system and the industrial system are examined in terms of the costs involved. The balance sheets of the cheese dairies and the cheese maturing firms are also analysed in order to estimate the extra resources employed in these two types of firms. The chapter concludes with an assessment of the employment effects of the Parmigiano-Reggiano system and how the system can create more jobs with respect to the industrial dairy system.

10.2 Technical efficiency of the dairy farms

Accounting data and data from the questionnaire is available for a representative sample of 77 dairy farms specialised in milk production. In the following analysis two groups will be distinguished: first dairy farms

that deliver milk to a Parmigiano-Reggiano cheese dairy and second dairy farms that deliver milk either to a cheese dairy producing Grana Padano cheese or to a dairy industry that produces industrial dairy products including pasteurised milk, UHT milk, yoghurt, desserts and industrial cheeses. Although the Grana Padano production system has its own production regulations as far as cow feeding is concerned the differences between this system and the system practised on industrial dairy farms is so small that in the following analysis they have been amalgamated in one single group. An important factor unifying these two types of farms is their reliance on maize silage. This crop is economically the most convenient roughage in the zero-grazing based dairy farms in the Po Valley. In the following the Grana Padano farms and industrial dairy farms will be simply referred to as 'industrial farms'.

As may be seen from Table 10.1 the division of the sample according to the end use of the milk and by altitude zone produces a sufficiently homogeneous result. Looking at the table it is clear that there is a significant difference in the size of the mountain dairy farms and those based on the plain. This is independent of the end use of the milk. In the mountains average herd size is about 25 milking cows compared to 50 to 60 cows on the plain. The industrial mountain farms are mainly located in the province of Piacenza. They are usually small and milk yield per cow is generally low.

Table 10.1 Dairy farm structure and technical efficiency of farm sample

	Destination of milk			
	Parmigiano Reggiano		Industrial milk	
	Mountains	Plains	Mountains	Plains
Number of milking cows	26	48	24	60
Production of milk per cow (kg/year)	5,430	6,730	4,580	7,020
Cultivated area (ha)	29.1	26.9	26.7	36.4
Forage crop area (ha)	26.6	22.9	21.2	30.2
Labour per cow (hours/year)	136.2	98.5	113.7	84.2
Labour per ha forage crop (hours/year)	113.3	53.9	118.5	46.8
Number of cows per labour unit	12.1	19.3	13.5	23.9
Number of cows per hectare forage crops	1.2	2.3	1.2	2.5
Concentrates per cow (incl.young stock)	2,212	2,334	1,227	2,062
Concentrates per kg of milk	415	349	267	279
Working capital per cow (mln ITL)	4.8	4.3	4.8	5.0
Land and buildings per cow (mln ITL)	22.7	23.4	19.2	24.5
Replacement rate (%)	16.1	24.2	16.7	26.6
Mortality rate of calves in first month (%)	5.7	6.7	4,3	3.2
Total number of farms	22	29	14	12

There is a clear distinction between the Parmigiano-Reggiano and the industrial dairy farms in the plains. It is particularly noteworthy that

farms in the Parmigiano- Reggiano system have a smaller average herd size with lower average yields than the industrial group. The farms belonging to the industrial milk production system are largely concentrated in the Province of Piacenza. These are very similar to the dairy farms operating on the other side of the Po River in the Lombardy region, where large-scale dairy farms predominate. Apart from their size, it is noticeable that these farms have a high level of capital investment per head of cattle. They use particularly intensive farming methods and labour productivity levels are high both in the cow-sheds and in the cultivation of forage crops. The average size for a Parmigiano-Reggiano dairy farm situated on the plain is about 50 lactating cows. These produce an average yield of 6,730 kilo of milk, which is four percent lower than in the industrial farms. Labour productivity is slightly lower too, but the capital invested matches the figure of the industrial farms.

The technical indices show that cattle is intensively used (replacement rate per year of milking cows 25 percent) which is in line with the parameters of industrial dairy farms. More striking is the high input of concentrates in the Parmigiano-Reggiano farms. This is an immediate consequence of the fact that silage of any sort is not permitted. On the industrial farms the high energy requirement of dairy cows of high genetic potential is met largely by maize silage, which reduces the need for concentrates in the feed ration. On the Parmigiano-Reggiano farms the use of green forage in summer and hay in the winter provides the main source of roughage. This has to be integrated with considerable quantities of concentrate feed. The consequences of these technical differences in feeding and reproduction for production costs will be analysed in the following paragraph.

10.3 Milk production costs

As might have been expected, milk production costs differ significantly depending on end use and area of production. So far as milk production for Parmigiano-Reggiano is concerned, the average cost of obtaining one kilogram of milk in 1998, was ITL 1,255 in the mountains and ITL 967 on the plain. On an industrial dairy farm costs are slightly higher in the mountains, but significantly lower on the plains. The cost variations that emerge from a comparison of the two systems on the plain give the true measure of difference between the two systems.

However, let us first examine the differences between dairy farms in the mountains and dairy farms on the plain. Generally speaking, in the

mountains the most significant cost components are labour costs and depreciation. The smaller size of the farms and working difficulties linked to a more hostile terrain limit labour productivity and increases costs of production. The labour cost of producing one kilogram of milk on the plain is ITL 404. In the mountains the same cost component for one kilogram of milk is ITL 664. The importance of depreciation in raising milk production costs is determined by the relatively high levels of machinery use (tractors and hauling machinery in particular) together with the value of the buildings. The fact that in the mountains production on Parmigiano-Reggiano farms involves a lower level of costs than on industrial farms can be explained by the larger herd size and the level of cow productivity.

Table 10.2 Production costs of milk according to destination and geographical area, 1998

	Parmigiano Reggiano				Industrial milk			
	Montains		Plains		Mountains		Plains	
	ITL/Kg	%	ITL/Kg	%	ITL/Kg	%	ITL/Kg	%
Costs of purchased feed	229	16.6	233	22.1	167	11.6	192	22.1
Var. costs forage production	72	5,2	70	6,6	89	6.2	59	6.9
Other variable costs	52	3,7	68	6,5	48	3,3	40	4.6
General costs	41	3.0	59	5.6	37	2.6	28	3.2
Depreciation	181	13.1	97	9.2	207	14.3	104	12.0
Labour	664	48.0	404	38.3	736	50.9	328	37.8
Interests	146	10.5	123	11.6	160	11.1	117	13.5
Total costs	1385	100.0	1055	100.0	1446	100.0	868	22.1
Non-milk output	130	10.5	88	8.4	142	9.9	110	6.9
Net production costs	1255	90.6	967	91.6	1303	90.1	758	87.3
Number of farms	22		29		14		12	
Average number of milking cows	27		49		25		60	
Milk production per cow (kg/cow)	5,070		6,430		4,250		6,820	

As has been stated before the cost comparison between the two production systems on the plain brings the differences between the production in sharper relief. Dairy farms producing milk for Parmigiano-Reggiano have to bear an additional cost of ITL 210 per kilogram of milk when compared to the costs of industrial milk. The extra cost borne in producing Parmigiano-Reggiano milk (in relative terms a difference of 21 percent) stem in particular from higher feed and labour costs.

The cost differential that derives from feed can be attributed to the different techniques used in the two systems. As we have noted above, the fact that maize silage is prohibited as feed for lactating cows under the Parmigiano-Reggiano regulations means that there is a higher level of concentrates in the feed. The costs for the purchase of concentrate feed is about 18 percent higher on the Parmigiano-Reggiano farms. On the other hand the industrial farmers have to face higher direct costs for the production of forage maize, but as the EU is granting a hectare premium for maize silage at the end the variable costs for the production of forage is still lower on the industrial farms.

There are other differences in the feed regimes of the two systems that affect cost. These relate to the extent to which feed is produced on-farm. Generally speaking, this is a practice more commonly found on medium-sized and large industrial farms. The on-farm method involves the buying of nucleuses, additives and cereals that are then mixed on the farm rather than buying concentrates as compounds in a finished form. This can be identified as another important factor differentiating the two groups as far as feed costs are concerned.

Size is an important factor as far as cost differentiation in relation to labour and depreciation are concerned. Both labour productivity and the value of the capital invested in the farm are linked to the size of the herd. An average herd size for lactating cows in the Parmigiano-Reggiano farm group is 48 cows. This means about a 100 head of cattle including young stock. On an industrial farms there would be a herd size of 60 cows. The greater cost of labour in the Parmigiano-Reggiano system is a consequence of the work involved in the production of hay and green roughage which, is fed fresh every day to the cows during the summer months.[1]

Capital investment, both in buildings and machinery, is obviously connected to the size of the farm. Lastly, it will be seen that the cost component arising from interest charges is slightly larger in the Parmigiano-Reggiano group of farms. This is because of the longer financial exposure that the farms have to cope with because of the way in which they are paid for their milk. In this respect a distinction has to be made within the group of industrial farms. Those who deliver to the large-scale dairy industry will receive milk payments within two months of delivery. The dairy farmers who deliver milk to a Grana Padano cheese dairy may experience a delay of more than six months. The Parmigiano-Reggiano farmers, however, are the worse off because, in general, they have to wait for more than a year until they are paid for their milk. The principle being that first the cheese has to be sold.

10.3.1 Milk production costs and farm size

One of the crucial factors that has an important bearing on milk production costs is herd size. As farms grow in size, unit milk production costs fall. This is the normal working of economies of scale. Table 10.3 shows that net cost decreases in relation to increases in the scale of production. So far as the Parmigiano-Reggiano farms on the plain are concerned, the cost of producing one kilogram of milk ranges from ITL 1,078 on small farms to ITL 882 on larger ones. There is a parallel reduction of milk production costs for the industrial farms when the medium-sized farms are compared with the larger ones. Costs range from ITL 801 for the medium-sized farms to ITL 726 per kilogram in the larger farms.

Table 10.3 Production costs of milk according to farm size, 1998, plains farms (ITL/kg)

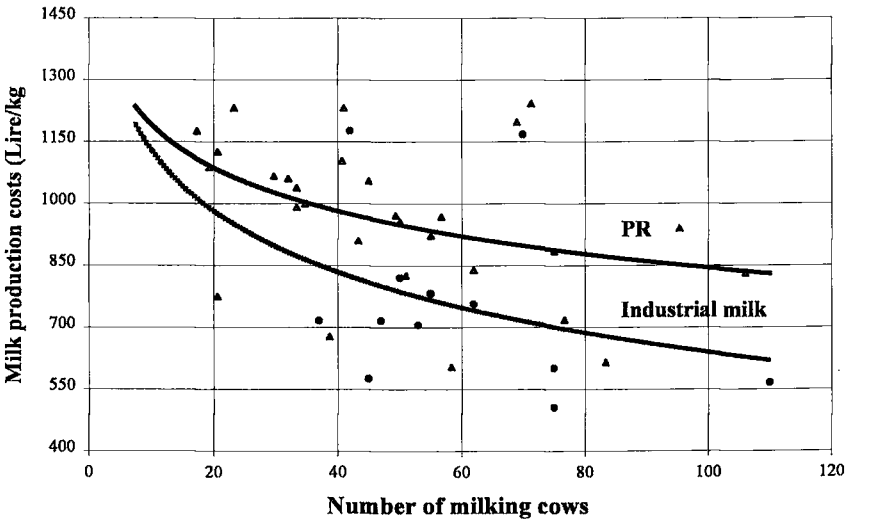
	Parmigiano-Reggiano farms			Industrial farms	
	< 25 cows	25-50 cows	> 50 cows	25-50 cows	> 50 cows
Costs of purchased feed	262	245	209	229	166
Var. costs forage production	77	67	69	52	65
Other var.costs	76	61	72	45	37
General costs	71	60	55	27	28
Depreciation	103	108	84	87	116
Labour	466	411	372	350	312
Interests	124	134	111	93	133
Total costs	1,179	1,085	972	882	857
Non-milk output	101	81	90	81	131
Net production costs	1,078	1,005	882	801	726
Number of farms	5	12	12	5	7
Average number of cows	20	39	72	44	71
Milk production per cow (kg/cow)	6,390	6,160	6,720	6,780	6,850

The curve described in Figure 10.1 confirms the relationship between size and cost reduction, but it is noticeable that the potential for economies of scale is greater on industrial farms than on Parmigiano-Reggiano farms. Calculations show that a herd of 100 lactating cows reduce milk production costs to ITL 850 per kilogram in the Parmigiano-Reggiano farms and to ITL 680 per kilogram in the industrial farms.

Labour is the most important cost benefit that derives from farm size. An increase in farm size results in an increase in labour productivity levels as a result of the increased technological content and rationalisation of the working process. The economies of scale are less pronounced on the Parmigiano-Reggiano farms, because the mechanisation of field operations in particular cannot be pushed any further than they have been pushed

already. On industrial farms the use of maize silage, in combination with the use of feed mixing technology makes it possible to reduce milk production costs more sharply on large farms.

Figure 10.1 Production costs of milk according to herd size, 1996



10.3.2 Milk production costs and cow productivity

The second component that is of critical importance in milk production costs is the productivity of the herd itself. The average yield per cow, in addition to being of fundamental importance in the assessment of technical efficiency, is closely linked to milk production costs. As herd productivity grows milk production costs diminish because of the contraction of fixed costs per kilo of milk. The decrease of the fixed costs like labour and depreciation is more than proportional to the increase in the variable costs per kilo of milk. With an increase of the milk yield per cow cost variable cost items increase per kilo milk:

1 the feed costs increase because the high energy requirements of the high yielding cows have to be met by an increasing amount of concentrates in the feed ration. This is in particular the case for the Parmigiano-Reggiano farms as these basically can rely only on hay and green forage which generally have a rather low energy content with respect to maize silage;
2 the variable cattle costs increase as the high yielding cows require a higher veterinary care. These cows become more and more vulnerable

to decease and only a high technical capacity of the farmer may prevent a considerable increase of veterinary and medicine costs.

Table 10.4 Production costs of milk according to cow productivity, 1998, plains farms (ITL/kg)

	Parmigiano-Reggiano farms			Industrial farms	
	< 5,000 kg	5,001–6,500 kg	> 6,500 kg	5,001–6,500 kg	> 6,500 kg
Costs of purchased feed	189	239	237	157	217
Var. costs forage production	72	62	74	61	59
Other var.costs	51	69	71	30	48
General costs	68	60	58	42	18
Depreciation	117	107	88	116	96
Labour	519	418	374	495	209
Interests	176	130	109	157	87
Total costs	1,192	1,084	1,011	1,057	732
Non-milk output	71	95	87	148	83
Net production costs	1,121	988	924	910	649
Number of farms	3	10	16	5	7
Average number of cows	47	46	52	53	65
Milk production per cow (kg/cow)	4,640	5,710	7,220	5,690	7,630

Figure 10.2 Production costs of milk according to cow productivity, 1996, plains farms

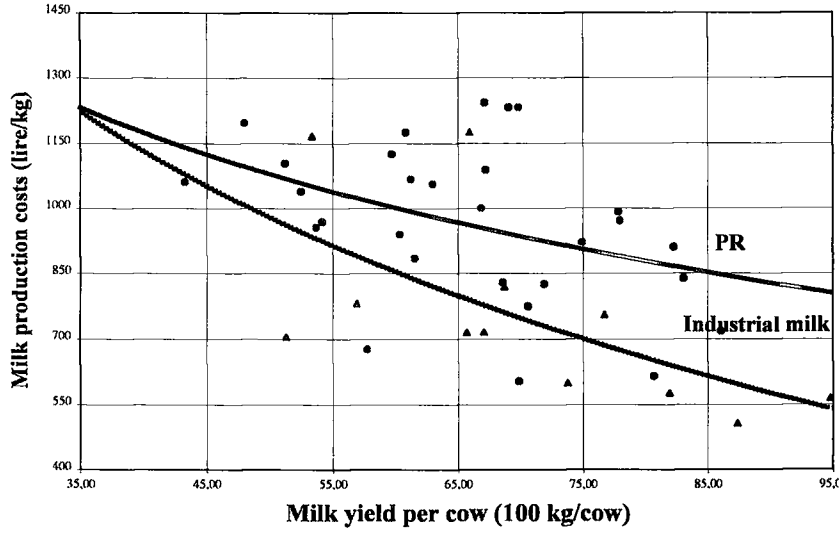


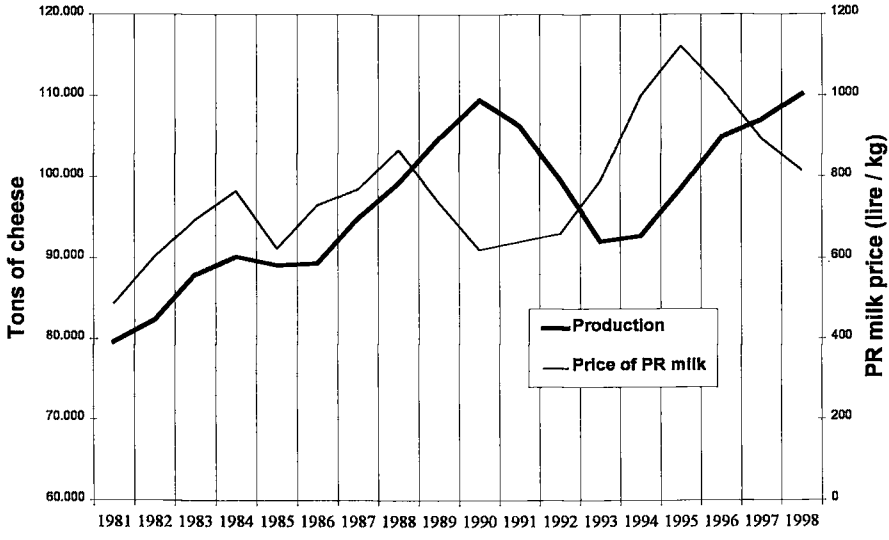
Figure 10.2 indicates that industrial farms are more successful in securing lower costs for high yielding cows than Parmigiano-Reggiano farms. The slope of the curve is steeper in the industrial farms, because the combination of maize silage and concentrates is more capable of meeting

the high energy requirements of high yielding cows. The need to increase the purchase of concentrates on these farms is less pronounced than on the Parmigiano-Reggiano farms and this is reflected in the lower production costs for milk for farms with high yielding cow farms.

10.4 Evolution of milk price

The market for Parmigiano-Reggiano is subject to strong price fluctuations that derive from the difficulties of adjusting supply to demand because of the time lag of at least 18 months between production and final consumption. Every five or six years a fall in prices is registered. In 1980 and 1985 prices fell slightly as demand failed to absorb excess production. A severe crisis occurred at the beginning of the nineties when, after a steady growth in production, overproduction was unable to find remunerative markets. Prices collapsed and a long market crisis began. This lasted three years and was only resolved after substantial cuts in production. Subsequently both cheese and milk prices rose again to very high levels.

Figure 10.3 Production of Parmigiano-Reggiano cheese and milk price development 1981-1996



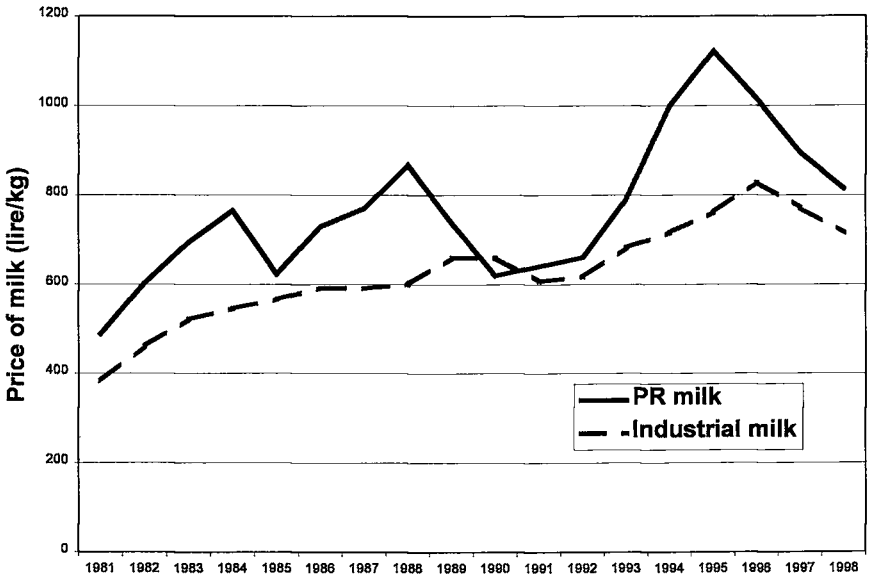
The alternative milk market outlet for dairy farmers within the Parmigiano-Reggiano region is the production of milk for the large-scale dairy industry. Until the introduction of the Euro in 1999, this milk price

was strongly influenced by the exchange rate of the Italian lire, because more than 10 percent of the liquid milk market depended on imports from Germany and France. When exchange rates were high it became more convenient to buy milk from Italian dairy farmers. The demand for Italian industrial milk increased as did the price. When the lire devaluated, however, import prices declined and the demand for Italian milk went down. Dairy farmers within the Parmigiano-Reggiano region may switch over to producing industrial milk especially when the price of industrial milk approaches the price paid for milk used to make Parmigiano-Reggiano cheese. This happened in the early nineties when the production of milk for Parmigiano-Reggiano declined. A number of dairy farmers switched over to industrial milk and small Parmigiano-Reggiano farmers closed down their farms.

As far as the technology associated with feed is concerned, it is easier to convert to industrial milk production than to convert to a Parmigiano-Reggiano system. When an industrial dairy farm decides to join a Parmigiano-Reggiano dairy, it takes a long time before the cows used to consuming large quantities of silage will be adapted to the new feed regime required for the milk destined to Parmigiano-Reggiano cheese[2]. Frequently farmers who have switched over do not return to the Parmigiano-Reggiano system, although the strong price increase for Parmigiano-Reggiano milk has attracted farmers to turn back. Explaining this in terms of institutional economics, it can be said that the switch over from industrial to Parmigiano-Reggiano milk requires a technological change at the farm level which generates high transformation costs. Moreover, the transaction costs of the switch over will be high because the farmer has to negotiate with a Parmigiano-Reggiano cheese dairy before he is accepted as a new member. Acceptance will depend on the production capacity of the dairy and the eagerness of its members to maintain a high milk quality standard. Former industrial farmers have to prove that they can maintain standards. The switch over in the opposite direction creates lower transformation and transaction costs. Hence, leaving the Parmigiano-Reggiano system is often an irreversible decision.

The average price advantage that milk produced for Parmigiano-Reggiano cheese held over industrial milk in the period 1981-1996 was 21 percent. Only in the years 1990-1992 was the price of Parmigiano-Reggiano milk lower than the price of industrial milk.

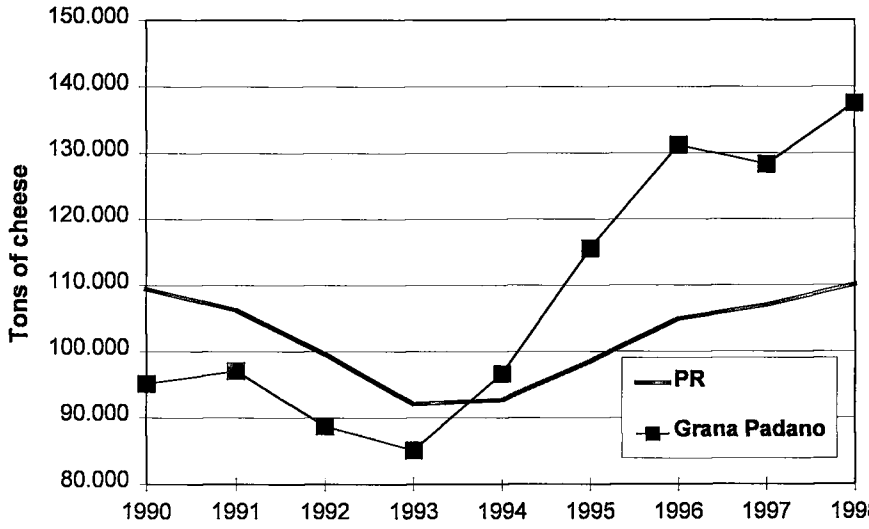
Figure 10.4 Price development of milk for Parmigiano-Reggiano and industrial milk 1981-1996



Source: For PR milk: reference price for milk destined to PR cheese in the province of Parma
For industrial milk: Industrial milk price agreements stipulated between Region Emilia-Romagna and Milk Producers Associations (AIPLE, APLER, APL and AIPROLAT)

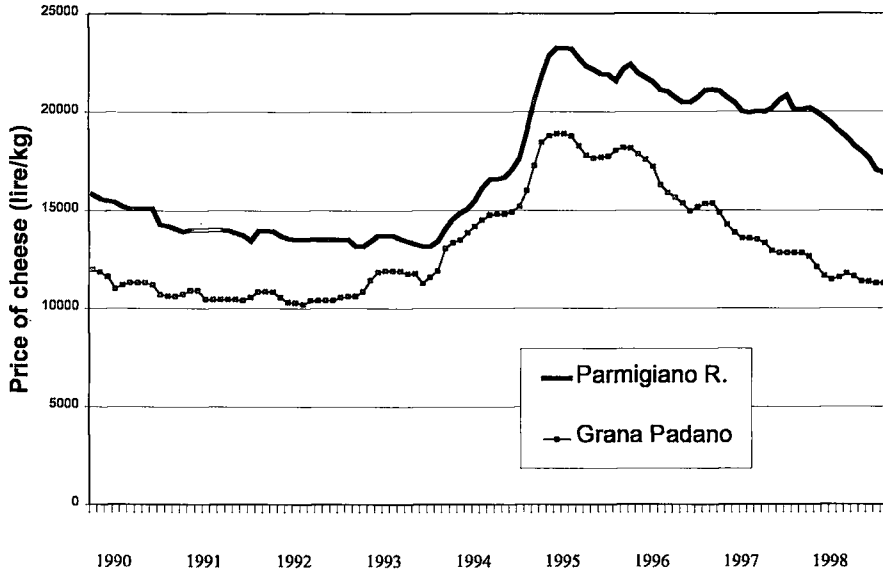
For an analysis of the most recent price development (1995-1999) it is interesting to enlarge the comparison to price of milk destined to the production of Grana Padano cheese. Evidently this milk price is strongly influenced by the fluctuations of supply and demand of Grana Padano cheese. The supply of Grana Padano cheese can be increased more easily, because the Grana Padano system is a more flexible one. Cheese dairies operating within the Grana Padano supply chain also produce other cheeses, such as Provolone and Asiago. The destination of the milk received by these dairies is thus determined by the relative profitability of the different cheeses. For many years Grana Padano cheese has been extremely profitable and, as a result, huge quantities of milk have been directed towards its production. The manufacture of Parmigiano-Reggiano reacted positively but less strongly to the very remunerative price levels of 1994 and 1995. Between 1993 and 1998 Parmigiano-Reggiano production rose by almost 20 percent. However, over the same period Grana Padano cheese production increase by more than 60 percent.

Figure 10.5 Production of Parmigiano-Reggiano and Grana Padano cheese 1990-1998



Source: Elaborated on data Consortium PR cheese and Consortium GP cheese

Figure 10.6 Prices of Parmigiano-Reggiano and Grana Padano cheese at wholesale level 1990-1998

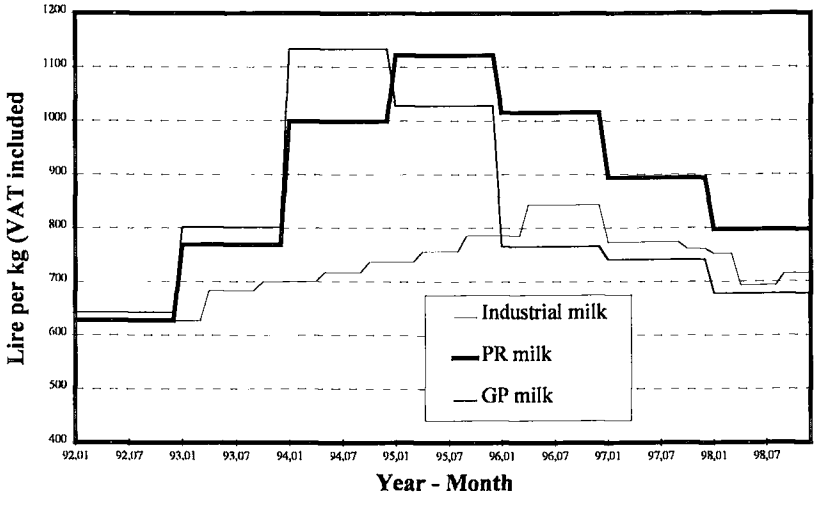


Source: Elaborated on data Chamber of Commerce Reggio Emilia and Milan

In 1996 and 1997 the price gap between the two Grana cheeses increased to about ITL 9,000 per kg, as Grana Padano prices collapsed. From 1998, the price of Parmigiano-Reggiano cheese also started to decline, but this was due to an increase in production and to an enormous decrease in the price of Grana cheeses as a whole. To a certain extent Grana Padano cheese has dragged Parmigiano-Reggiano prices into the most serious price crises ever.

Now, when we compare the development of the three milk prices (for Parmigiano-Reggiano cheese, Grana Padano and industrial processing), we notice that in the last three years there has been a convergence towards similar price levels for all three products. Given the production cost differences between milk for Parmigiano-Reggiano cheese on the one hand and Grana Padano and industrial processing on the other, this development is certainly not an optimistic one for Parmigiano-Reggiano dairy farmers. In Chapter 5 we noticed that the decline in the number of Parmigiano-Reggiano dairy farmers accelerated particular quickly in 1998. To overcome this crisis new agreements have to be established between actors in the system – dairy farmers, cheese dairies and maturing firms – involving a strong convergence of objectives.

Figure 10.7 Milk prices paid for milk destined to PR cheese, GP cheese and for industrial processing



Source: For PR milk: Reference price for PR cheese in the province of Parma
For GP milk: Average milk price paid by cheese dairies in the province of Piacenza
For industrial milk: Industrial milk price agreements stipulated between Region Emilia-Romagna and Milk Producers Associations (AIPLE, APLER, APL and AIPROLAT
Source: Own calculations on data ISTAT and INEA

10.5 Profitability of milk production

In this paragraph we will discuss how these price differences are related to the cost differences set out earlier in this chapter. Are the differences in milk price sufficient to account for the cost differences set out earlier? As the alternative for Parmigiano-Reggiano dairy farmers is the production of industrial milk the price of milk for these two milk destinations has been compared to the production costs of milk. A comparison has been made for the dairy farmers in the plains as well as for the dairy farmers working in the mountains.

Table 10.5 Evolution of profitability of milk production for Parmigiano-Reggiano and industrial milk in the plains1990-1997

	Parmigiano-Reggiano			Industrial milk		
	Costs	Price	Profit/ Loss	Costs	Price	Profit/ loss
1989	742	721	-21	640	661	21
1990	780	608	-172	658	661	24
1991	808	598	-210	663	608	-34
1992	823	627	-196	674	627	-26
1993	831	769	-62	679	673	15
1994	851	999	148	698	716	39
1995	931	1122	191	765	761	19
1996	1011	1015	4	841	829	-12
1997	1009	1001	-8	839	771	-68
Deflated average	1008	955	-53	837	818	-19

As the cost variations are much more limited than the milk price variations for Parmigiano-Reggiano cheese, the profitability of milk production varies considerably from year to year. After a price *hausse* at the end of the 1980s production expanded strongly and prices collapsed. Consequently farm losses were considerable for three years. Afterwards the low profitability suffered at the beginning of the 1990s was gradually restored.

Industrial milk production is much less subject to price variations. Its profitability is more stable over time there is the advantage that farmers are able to plan better investments in the long run. Parmigiano-Reggiano farmers prefer to invest during years when prices are high. In 1995 and 1996 the price of milk destined for Parmigiano-Reggiano cheese was about 40 percent higher than milk processed for industrial purposes.
The profitability levels of the two farming systems in the plains are comparable and both systems are economically valid alternatives. The

deflated average losses in both systems are limited and slightly more in favour of industrial milk production. The eight-year average profitability of milk production for Parmigiano-Reggiano cheese is acceptable, particular given the high cost sustained. The advantage of the Parmigiano-Reggiano system is that higher production costs are, on average, covered by higher prices, which account for the input of more resources.

In the mountains, the milk price in both systems is insufficient to remunerate inputs of capital and labour at adequate levels. The differences in losses between the two systems are of particular interest. As the industrial milk production system is not able to exploit cost reducing practices and technologies in the mountains, the production costs for this type of milk can be compared to the costs of producing milk for Parmigiano-Reggiano cheese. The dairy farmers of Parmigiano-Reggiano milk can reckon on receiving higher milk prices than their colleagues in the plains. According to a study of cheese dairies in the province of Reggio Emilia (Corradini and Bergianti 1997), the price difference between the plains and the mountains amounts 4.5 percent in favour of the cheese dairies in the mountains. This price difference derives from the fact that cheeses produced in the mountains are of higher quality and this is reflected in the selling price of cheese.

The price of industrial milk in the mountains does not receive any premium. On the contrary, the higher cost of milk collection means that the milk price these farmers receive is lower than that received by their colleagues in the plains.

Table 10.6 Evolution of profitability of milk production for Parmigiano-Reggiano and industrial milk in the mountains-1997

	Parmigiano-Reggiano			Industrial milk		
	Costs	Price	Profit/ Loss	Costs	Price	Profit/ Loss
1989	986	753	-233	1013	661	-352
1990	1037	635	-402	1042	661	-381
1991	1048	625	-423	1061	608	-453
1992	1073	655	-418	1087	627	-460
1993	1105	804	-301	1112	673	-439
1994	1119	1044	-75	1136	716	-420
1995	1202	1172	-30	1208	761	-447
1996	1299	1061	-238	1337	829	-508
1997	1309	1046	-263	1354	771	-583
Deflated average	1319	998	-321	1341	818	-522

A particularly important conclusion that can be derived from a comparison of the two production systems in the mountains is the significantly better economic performance of Parmigiano-Reggiano farms in this area. The price here for Parmigiano-Reggiano milk is not only higher because it is destine for Parmigiano-Reggiano cheese, but also its higher quality is remunerated by the cheese maturing firms and wholesalers, which generates a higher milk price than the price paid for Parmigiano-Reggiano in the plain. This gives an important economic stimulus to dairy farmers in the less favoured mountainous areas of the Apennines. The consequences for employment and the maintenance of the rural population will be dealt with in the last paragraph of this chapter. First, we will go into the details of cheese dairy balances in order to analyse the resources employed in the Parmigiano-Reggiano system.

10.6 Cheese dairies

Among cheese-making dairies in the Parmigiano-Reggiano area, co-operative dairies are in the majority. In 1998, 85 percent of the milk used in the production of Parmigiano-Reggiano was processed by this type of dairy. The general objectives of the co-operatives differ significantly from those of privately owned undertakings. A quotation taken from the constitution of a co-operative dairy states that: 'The co-operative aims to assist its members to participate in obtaining the benefits of co-operative working'.

Within the group of co-operative dairies two different kinds of management can be identified. This identification is based primarily on the system through which the cheese-maker is remunerated.

1 Direct management cheese dairy
2 Contracting out cheese dairy.

In the direct management cheese dairies, the cheesemaker and his assistants are paid as employees of the co-operative and their employment contract is linked to a general contracting arrangement with incentive payments added by the dairy as a reward for the quality of the cheese produced. In dairies where work is contracted out, the cheesemaker receives a lump sum payment calculated in accordance with the quantity and quality of the cheese produced. This money must be used by the cheesemaker to purchase all the materials required in the cheese-making process (rennet, cloths etc) and for the salaries to be paid to himself and his assistants. The co-operative dairies that contract out are

found almost exclusively in Parma where this contractual form of dealing with the cheesemaker has its historical roots.

A processing cost analysis has been performed based on the balance sheets of 136 cheese dairies. Of the all the cost items three-year averages have been calculated in order to eliminate year-to-year fluctuations.

10.6.1 The sample of cheese dairies

An analysis of the sample showed that 72 dairies were located on the plains and 64 are situated in the mountains. When this sample distribution is compared to the total number of dairies in 1998, there is a high degree of representativeness. The sample represents 22 percent of the total number of cheese dairies in the area. More specifically this is 17 percent of the dairies in the plains and 34 percent of the mountain dairies.

Table 10.7 Size distribution of the total number and research sample of cheese dairies-1998

	Plains		Mountains		Total		Sample
	n.	%	n.	%	n.	%	% of total
	Number of cheese dairies in the sample						
Up to 1,000 tons	1	1.4	19	29.7	20	14.7	15,0
1,000 - 2,000 tons	32	44.4	30	46.9	62	45.6	19,8
2,000 - 4,000 tons	29	40.3	13	20.3	42	30.9	24,9
More than 4,000	10	13.9	2	3.1	12	8.8	20,3
Total	72	100,0	64	100,0	136	100,0	20,2
	Total number of cheese dairies						
Up to 1,000 tons	50	11.3	47	23.5	97	15.2	
1,000 - 2,000 tons	164	37.4	99	49.5	263	41.1	
2,000 - 4,000 tons	154	35.1	50	25.0	204	31.9	
More than 4,000	71	16.2	4	2.0	75	11.7	
Total (*)	474	100,0	200	100,0	639	100,0	

Source: For data universe of cheese dairies: Consorzio Formaggio Parmigiano-Reggiano

The sample reflects the size of the various cheese-making dairies. Within the sample as a whole only the smaller dairies (processing less than 1,000 tons of milk a year) were slightly under-represented (14 percent of the sample as against 19 percent of the whole). The sample was fairly representative for medium- and large-sized dairies. The percentages for these last two categories in line with the percentage figures of the total number of cheese-making dairies.

A third sub-division of dairies was made according to type of management. 101 dairies in the sample were being managed directly and employed a cheese-maker and his assistants. Thirty-five dairies were managed under contract by a cheese maker. These contract-managed dairies were only found in the Province of Parma and were equally distributed over mountains and plain. Finally, 83 of the dairies in the sample also raised pigs on the whey derived from processing the milk.

10.6.2 Analysis of milk processing costs

Two sources of data were used in calculating the cost of processing milk into Parmigiano Reggiano cheese:

1 The dairies' balance sheets for the years 1995, 1996 and 1997
2 Data from the replies of cheese makers and dairy chairmen to a questionnaire drawn up especially for this research[3]

The first step taken in the processing of the data derived from the accounts was the re-classification of cost headings into 70 homogeneous categories. These were subsequently brought together into 18 individual items under five headings. The three-year average for 1996 was updated to the year 1998 using the cost index for each item.

The sample was divided into two groups on the assumption that the type of management involves significant differences in cost structure. The first group was made up of directly managed cheese making dairies, while the second group consisted of dairies where milk processing took place under contract. The average size - measured in terms of the quantity of milk processed per year - of the 101 dairies under direct management was about 2,300 tons of milk. Dairies that contracted out processed 2,032 tons of milk per year.

In the cheese dairies on the plains the average processing cost per ton of milk is ITL 277,560 excluding milk transport costs. Equivalent costs made by cheese dairies in the mountains were ITL 295,020 per ton of milk. Taking milk transport costs into account the total costs rise to ITL 298,870 in the plain and ITL 325,620 in the mountains.

The posts that have the greatest bearing on total costs are labour (38 percent) and depreciation (seven percent). There are also items whose share of total costs range from four percent to eight percent. These include raw materials (rennet, salt, cloths) (eight percent), the transport of the milk (eight percent), quality marking (seven percent) and interest charges on advances and fuel (four percent). General expenses are still significant

in this picture (administration, book-keeping and accounts, taxes, and maintenance) and represent 12 percent of total costs. Interest charges on capital and off-premises storage together account for more than three percent.

Table 10.8 Composition of milk processing costs in 1998, direct management

	Plain		Mountain	
Number Cheese Dairies	55		46	
Milk Processed (tons/year)	2,996		1,440	
	ITL/ton	%	ITL/ton	%
Raw Materials	20,440	6.8	22,480	6.9
Electricity	9,220	3.1	7,370	2.3
Fuels	11,880	4.0	17,040	5.2
Labour	115,080	38.5	122,080	37.5
DIRECT PRODUCTION COST	**156,620**	**52.4**	**168,970**	**51.9**
Chemical Assistance	5,850	2.0	8,100	2.5
Marking	17,900	6.0	18,170	5.6
Insurance	3,020	1.0	1,950	0.6
COSTS OF SERVICES	**26,670**	**9.0**	**28,220**	**8.7**
Storage	17,320	5.8	7,750	2.4
Cheese transport	1,580	0.5	720	0.2
Sales costs	3,430	1.1	2,740	0.8
MARKETING COSTS	**22,320**	**7.5**	**11,200**	**3.4**
Administration	9,890	3.3	10,220	3.1
Accounting and Book-keeping	11,250	3.8	13,020	4.0
Taxes and Duties	4,300	1.4	5,180	1.6
Normal maintenance	9,830	3.3	11,980	3.7
GENERAL COSTS	**35,270**	**11.8**	**40,410**	**12.4**
Interest on Advances	9,640	3.2	9,950	3.1
Interest on Invested Capital	7,770	2.6	10,360	3.2
Depreciation	19,250	6.4	25,900	8.0
INTERESTS AND DEPRECIATION	**36,590**	**12.2**	**46,210**	**14.2**
TOTAL PROCESSING COSTS	277,560	92.9	295,020	90.6
Milk Transport	21,300	7.1	30,600	9.4
TOTAL COSTS	298,870	100.0	325,620	100.0

Source: Own calculations.

From this comparison it appears that the plain-based dairies spend less than mountain dairies on labour, fuel, interest charges, depreciation and transporting of milk. The mountain dairies, on the other hand, spend less on insurance, and on the sale and marketing costs (cheese transport, storage and commission).

The 37 Parma dairies managed under contract process, on average, 2,000 tons of milk. Average processing cost works out at ITL 303,110 per ton.

Table 10.9 Composition of milk processing costs with contract labour - 1998

	Plain		Mountain	
Number of dairies	18		18	
Milk Processed (tons)	2,038		2,027	
	ITL/ton	%	ITL/ton	%
Raw Materials	3,630	1.3	7,420	2.3
Electricity	4,010	1.4	3,770	1.2
Fuels	210	0.1	2,060	0.6
Contract	134,400	46.7	143,610	44.9
DIRECT PRODUCTION COSTS	142,240	49.4	156,870	49.1
Chemical Assistance	5,440	1.9	5,310	1.7
Marking	18,310	6.4	18,330	5.7
Insurance	4,310	1.5	2,520	0.8
COSTS OF SERVICES	28,050	9.7	26,160	8.2
Storage	12,980	4.5	8,270	2.6
Cheese transport	300	0.1	1,070	0.3
Sales costs	3,110	1.1	3,240	1.0
MARKETING COSTS	16,400	5.7	12,580	3.9
Administration	6,880	2.4	8,300	2.6
Accounting and Book-keeping	8,610	3.0	10,030	3.1
Taxes and Duties	4,500	1.6	5,110	1.6
Normal maintenance	7,910	2.8	6,770	2.1
GENERAL COSTS	27,900	9.7	30,200	9.5
Interest on Advances	8,580	3.0	9,030	2.8
Interest on Invested Capital	8,130	2.8	9,360	2.9
Depreciation	20,330	7.1	23,400	7.3
INTERESTS AND DEPRECIATION	37,040	12.9	41,790	13.1
TOTAL PROCESSING COSTS	251,630	87.4	267,600	83.8
Milk Transport	36,140	12.6	51,920	16.2
TOTAL COSTS	287,770	100.0	319,520	100.0

Source: Own calculations

The most important cost are contract cost (45 percent) quality marking (seven percent), interest on advances (four percent), and interest on invested capital (four percent). General costs (administration, book-keeping and accounts, taxes and maintenance) account for nine percent of total costs. The cost of off-premises storage amounts to about three percent of the total cost.

Costs in contract labour dairies are between four and nine percent lower that the costs incurred in dairies that are directly managed. Savings are

made on direct processing. The contract labour dairies provide the cheese maker with a lump sum with which he has to manage the process of cheese making and pay for the labour and raw materials required.

10.6.3 Processing costs and size of cheese dairy

There is a wide variation among dairies as far as the cost of processing milk is concerned both on the plain and in the mountains. The factors that had the greatest impact on milk processing costs were analysed using a statistical multivariate analysis of correlation and regression. This showed that the largest and smallest unit costs in milk processing depend on three elements:

1 The size of the cheese dairy
2 The extent to which the production capacity of the dairy is brought into use
3 The cheese yield of the milk, in terms of kilograms of milk per kilograms of cheese

Before examining the overall effect of these factors on processing costs, we will analyse the significance of the individual factors. Dairy size has been assessed on the basis of two indicators: the amount of milk processed (in tons) and the amount of the capital invested. The extent to which the production capacity of the plant is utilised has been calculated by dividing the average quantity of milk processed by the number of cheese vats present in the dairy. One vat may contain a maximum of 1,200 kilo of milk.

Table 10.10 Milk processing costs according to dairy size, direct management

	< 1,000 tons	1,001–2,000 tons	2,000–4,000 tons	> 4,000 tons
Number of dairies	17	42	32	10
Milk processed (tons)	791	1,524	2,764	6,514
Direct processing costs	200,950	162,930	151,620	127,540
Cost of services	27,920	27,440	27,620	25,930
Marketing costs	12,390	17,840	20,050	14,180
General costs	50,150	37,460	33,650	29,560
Interest and depreciation	57,860	43,530	34,620	21,750
Total processing costs	349,260	289,210	367,560	218,950
Milk transport	34,690	25,600	23,350	19,560
Total costs	383,960	314,810	290,910	238,510

Source: Own calculations

The directly managed cheese dairies have been divided into four groups according to the amount of milk processed:

1 The first group consists of dairies processing less than 1,000 tons of milk;
2 The second is composed of dairies processing between 1,000 and 2,000 tons;
3 The third is made up of dairies processing between 2,000 to 4,000 tons;
4 The fourth group is composed of dairies that process more than 4,000 tons.

Processing costs in small dairies that process less than 1,000 tons are about ITL 383,960 for each ton of milk. In the small- to medium-sized dairies processing between 1,000 and 2,000 tons cost amount to ITL 314,810 per ton. In medium- to large-sized dairies costs are ITL 290,910 per ton. Finally, in the large dairies with a processing capacity of over 4,000 tons, costs per ton decrease to ITL 238,510. The variations between these different groups can be attributed to labour costs, interest charges and depreciation on invested capital.

In the large cheese dairies a series of operations have been automated using relatively simple equipment. Possibilities for economies of scale are limited, however, given the current technological set up of these dairies. Cheese dairies are characterised by a modular subdivision of labour. Few economies of scale can be achieved once the dairy has reached a size of about 4,000 tons of milk a year because each vat requires a standard input of labour and equipment.

Table 10.11 Milk processing costs according to dairy size, contract management

	< 2,000 ton		> 2,000 ton	
Number of dairies	25		12	
Milk processed	1,464		3,215	
	ITL/ton	%	ITL/ton	%
Direct processing costs	153,560	48.6	141,830	51.9
Cost of Services	28,020	8.7	25,130	9.2
Marketing costs	15,500	4.8	12,230	4.5
General costs	30,330	9.4	26,470	9.7
Interest and depreciation	43,540	13.5	30,940	11.3
Total processing Cost	270,940	84.0	236,600	86.6
Milk Transport	51,440	16.0	36,600	13.4
Total costs	322,380	100.0	273,200	100.0

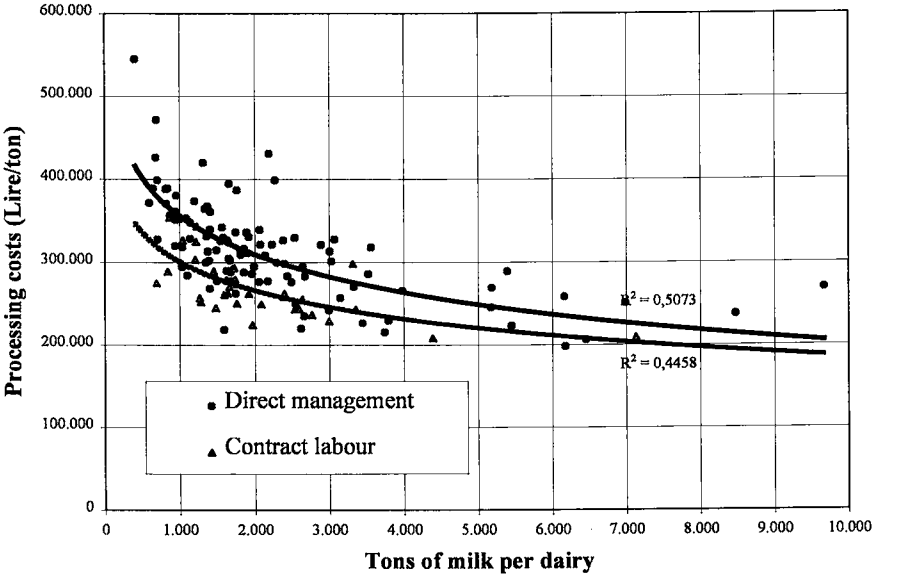
Source: Own calculations

A similar analysis applied to dairies managed under contract indicates that increased size results in reduced costs. In dairies that process an average of 1,460 tons of milk per year, the total processing costs amount to ITL 322,380 per ton. In the second group, where average production is about 3,210 tons, processing costs total ITL 273,200 per ton.

The greatest differences can be found in the cost of the contract, the interest on invested capital and in depreciation rates.

The data from the sample have been subjected to a regression analysis in order to analyse the influence of the size factor on milk processing costs in both types of cheese dairies. Figure 10.8 clearly shows the presence of economies of scale in both types of dairy. In the category 1,500 - 4,000 tons costs are cut by ITL 100,000 per ton of milk.

Figure 10.8 Milk processing costs according to dairy size



It should be noted that beyond 4,000 tons there is no longer a significant decline in the slope of the curves. This phenomena is analysed below.

10.6.4 Processing costs and use of production capacity

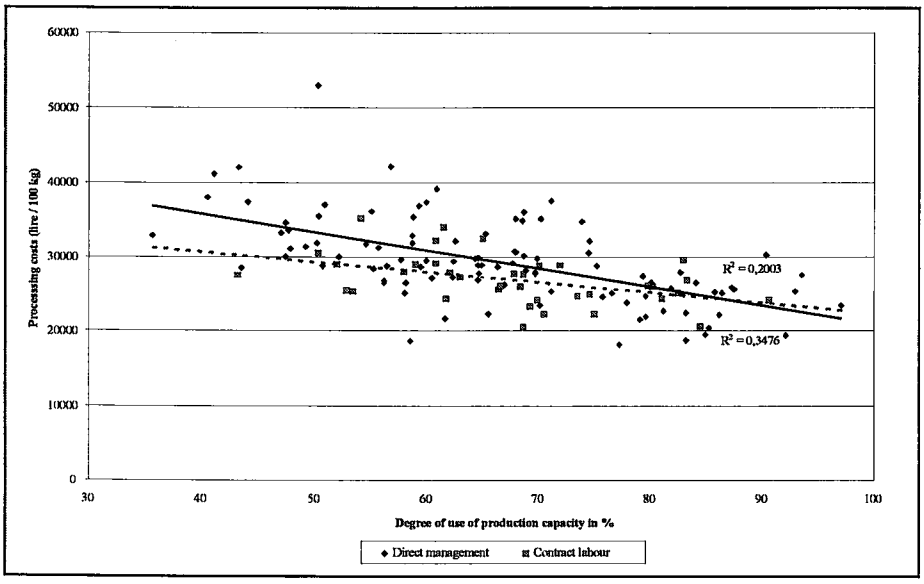
In the context of Figure 10.8 it should be noted that even where the quantity of milk processed and levels of capital investment are

comparable, processing costs are still highly variable. This indicates that other factors have an important role in determining milk-processing costs. Statistical analysis indicates that the most important of these is the degree to which the production capacity of the dairy is exploited. In other words, if processing costs are to be kept low the plant must work to full capacity.

As noted earlier, the use made of the plant has been calculated on the basis of the average quantity of milk processed per cheese vat in the dairy. The figure presented below indicates beyond doubt that when the plant is intensively used there is a drastic reduction in production costs. This is more evident in the figures from directly managed dairies than in contract managed dairies.

Figure 10.9 provides evidence of this cost reduction opportunity. It shows a difference of ITL 140,000 per ton of milk between dairies that use 50 percent of their production capacity and those that use 90 percent of their capacity.

Figure 10.9 Milk processing costs and use of production capacity

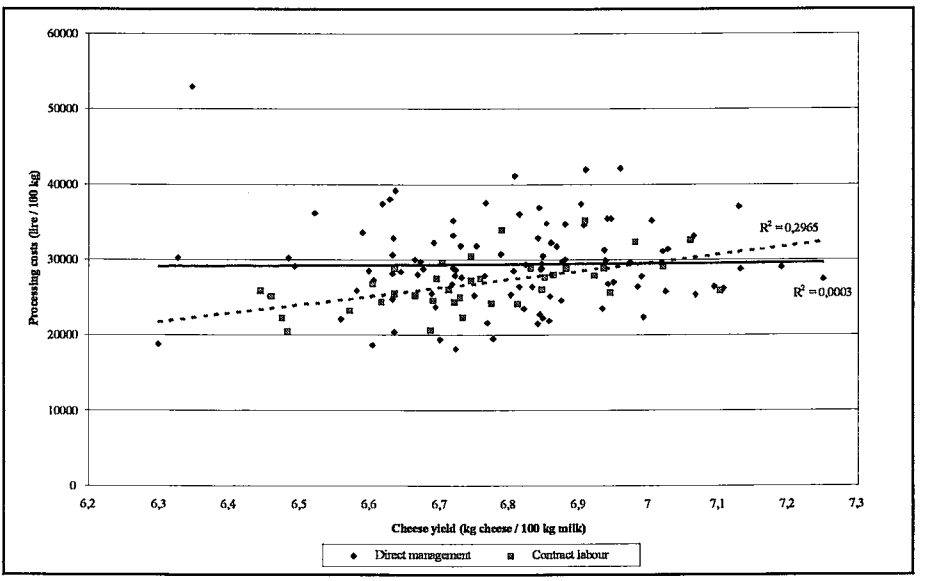


10.6.5 Processing costs and cheese yield

The correlation between cheese yield from the milk and processing costs are only significant for dairies under contract management. This can be explained by the fact that the production premium that has to be paid to

the contractor is of much greater significance for dairies that are under contract management than in those that are under direct management. These observations are supported by the data shown in figure 10.10 where processing costs only increase with higher milk-cheese ratios in dairies under contract management

Figure 10.10 Milk processing costs and cheese yield



10.6.6 Weight of the different factors

To complete the statistical analysis of the importance of individual variables in determining processing costs, a multiple regression equation has been used. The unit milk production costs have been taken as the dependent variable and the three variables discussed above (quantity of milk processed, extent to which the dairy is utilised, and the cheese yield of milk) have been taken as independent variables

Before being used in the multiple regression analysis, the three independent variables were subjected to a 'standardisation' process (average = 1, standard deviation = 0). This was done to ensure that the coefficients would give precise expression to the weight of the individual variables when explaining the variation in the processing costs.

The following regression equation was calculated in respect of the directly managed dairies.

PC = - 0,40.MP - 0,36 DGU - 0,07.CY R^2 = 0,457 Significant at P < 0,01
(-4,430)** (-4,007)** (-0,978)

in which PC = Processing costs
MP = Quantity of milk processed
DGU = Degree of use of plant
CY = Milk yield

An examination of the above equations shows that the most important and strategic variable is the size of the cheese dairy in terms of the quantity of processed milk. The degree to which the plant is used is the second most important factor. The cheese yield derived from the milk is of negligible importance for this group.

The following regression was calculated for the dairies under contract management:

PC = - 0.41.MP + 0,33.CY - 0.41 DGU R^2 = 0,532 Significant at P < 0,01
(-2,848)** (-2,568)** (-1,473)

The above equation indicates that the quantity of milk processed remains the variable with the greatest influence on processing costs. Compared to the directly managed cheese dairies, the cheese yield of milk makes a significant contribution to explaining the overall variation in processing costs. The degree to which the plant is used has only a marginal effect here, and is not of statistical significance.

10.7 The role of the cheese price in defining the level of the milk price

Now that we have analysed both the production costs and the processing costs of milk, an overall economic balance of the cheese producing activity can be made. This excludes the economics of maturing the cheese which is the subject of the next paragraph.

In many respects the economy of cheese production in these cheese dairies is closely related to the economics of milk production on the dairy farm. This is particularly true for the co-operatives, but is also relevant for the private cheese dairies that operate according to a very similar formula. To a certain extent the end product of the dairy farm is cheese, because the co-operative cheese dairy owned by 10 to 15 dairy farmers is, to some extent, an integral part of the dairy farm. The milk price is derived directly from the price of young or matured Parmigiano-Reggiano cheese, as sold by the cheese dairy. In addition to the cheese price, the value of the by-products and the level of processing costs play a role in the

definition of the milk price paid to the farmer. One of the by-products is butter. The majority of cheese dairies, though, sell the liquid cream to a local butter producing firm, as the costs of producing pasteurised butter is prohibitive for a single cheese dairy. When the cheese dairy raises pigs, as all dairies did in the past, the whey will be fed to the pigs. Otherwise it will be sold to local pig farmers or to whey processing firms. The final end value of the whey does not differ very much from one end use to the other. The table below presents an overall assessment of Parmigiano-Reggiano cheese production. In order to compare different values and prices they have been transformed in ITL per milk equivalent. From this overview the predominant role of the cheese price in defining the level of milk price becomes very clear.

Table 10.12 Economic performance of Parmigiano-Reggiano cheese dairies, direct management in plains 1990-1998 (in ITL per kg milk equivalent)

	1991	1992	1993	1994	1995	1996	1997	1998
	ITL/ kg	ITL/ kg	ITL/ kg	ITL/ kg	ITL/ kg	ITL/ kg	ITL/ kg	ITL/ kg
Wholesale price PR	1.028	977	916	1.085	1.421	1.247	1.219	1.092
Butter output +	70	71	85	92	112	91	99	90
Whey output +	7	7	9	10	12	9	9	9
Processing costs -	213	223	232	237	263	283	287	278
Implicit milk price	893	833	778	950	1.281	1.065	1.040	914
Milk production costs -	791	806	814	833	911	990	1.009	967
Profit/loss =	102	27	-36	116	370	75	31	-53

10.8 Costs of maturing cheese

An analysis of the cheese maturing costs brings this discussion on the costs of the Parmigiano-Reggiano to a close. Maturing cheese is a highly specialised activity and interests the life of the cheese from about 6-7 months up to about 18 to 24 months. In order to have a uniform estimate the maturing costs presented below refer to a 12-month period from 6 to 18 months. Two types of firms are presented:

1 Cheese dairies that directly carry out the maturing of cheese in a storage house
2 Large-scale cheese maturing firms

The balance sheets of the two groups of firms have been analysed to arrive at an estimate of the cheese maturing costs presented in Table 10.13.

Table 10.13 Cheese maturing costs in cheese dairies and specialised firms - 1998

Type of firm	Cheese dairy		Specialised firm	
Cheese matured /year	9,409		142,224	
	ITL/kg Month	%	ITL/kg month	%
Labour	15.3	9.4	14.0	8.7
Electricity	3.2	2.0	2.3	1.4
Maintenance	2.6	1.5	2.3	1.4
Insurance	1.6	1.0	1.7	1.0
Administration	1.5	0.9	2.5	1.6
MONETARY COSTS	24.2	14.8	22.8	14.1
Interest on floating capital	1.0	0.6	0.9	0.6
Interests on buildings	1.8	1.1	1.6	1.0
Depreciation	2.8	1.7	2.4	1.5
Weight loss of the cheese	72.9	44.7	72.9	45.3
Interests on cheese	60.3	37.0	60.3	37.5
INDIRECT COSTS	133.2	81.7	133.2	82.8
TOTAL GROSS COSTS OF MATURING	163.0	100. 0	160.9	100.0
EU Contribution	25.6	15.7	25.6	15.9
NET MATURING COSTS	137.4	84.3	135.3	84.1

The most important cost items are not the direct costs related to the activity itself (labour, energy costs etc.), but to cheese weight loss and the interests on the capital invested in cheese. In twelve months the cheese looses about 4.8 percent of its weight and the costs of this weight loss represents some 45 percent of the maturing costs. Interests on the capital immobilised in the storage houses weigh upon the total maturing costs for another 37 percent. The EU contribution reduces the total maturing costs by about 15 percent[4].

The economies of scale of this activity are not very pronounced, because the major part of the costs are represented by weight loss and the interest

on cheese capital. These are directly proportionate to the quantity of cheese involved.

The total cost of maturing cheese for 12 months is ITL 1,350 per kilo and this should be the minimum price difference between the wholesale prices of young unmatured cheese and matured Parmigiano-Reggiano cheese in order to be profitable. As we have seen, both markets are characterised by fluctuations and this is why maturing cheese is a rather risky business. Many of the firms involved in this activity have also entered other cheese markets not only to spread the risk, but also to be able to have a diversified supply of cheeses for the large retail sector. Although this is a perfectly legitimate and important firm strategy, the diversification policy of these firms weakens their economic link with the Parmigiano-Reggiano system. In other words, the interests of the Parmigiano-Reggiano system may not always match the objectives of the maturing firms. In particular, problems may rise around the quality definition of the cheese. For the system as a whole the specificity of the cheese with respect to its competitors on the market is important if it wishes to maintain its market share. However, some maturing firms might not be interested in this particular collective objective of the Parmigiano-Reggiano system, when their profits are high on lower quality and less specific Parmigiano-Reggiano cheese. This subject will be discused again in Chapter 12, the final chapter of the study.

Figure 10.11 Employment rate per cow in industrial and Parmigiano-Reggiano dairy farms (only farms in the plains)

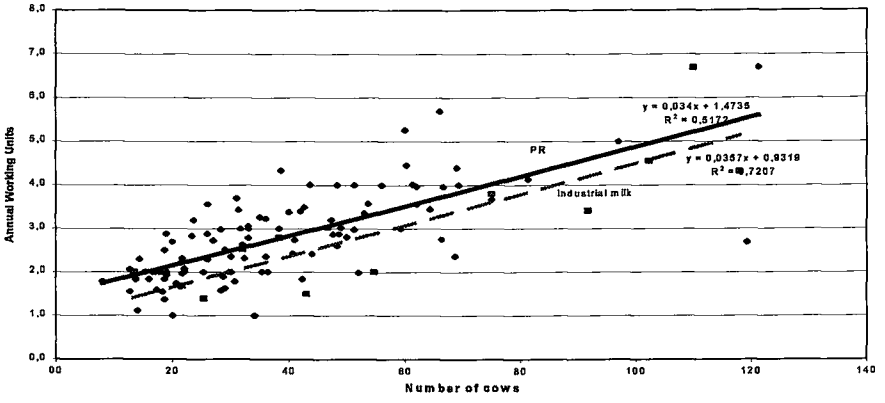
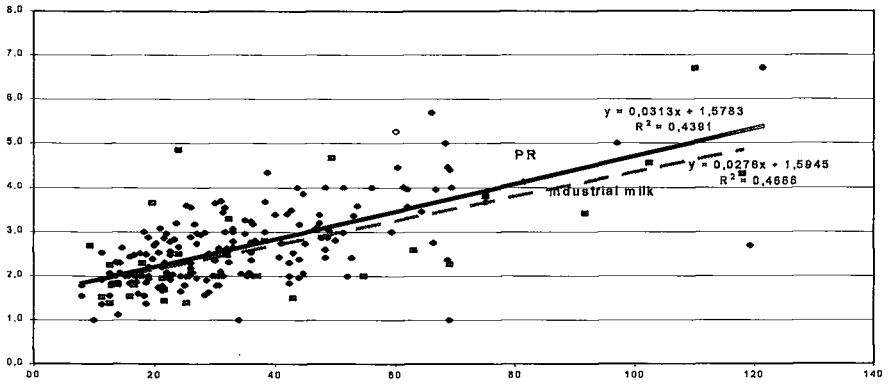


Figure 10.12 Employment rate per cow in industrial and Parmigiano-Reggiano dairy farms

(all farms)



10.9 Estimate of employment effect of the Parmigiano-Reggiano system

As labour intensity is higher on the Parmigiano-Reggiano farms more employment is created. An ad-hoc elaboration of farm sample data based on 214 dairy farms shows the main differences between the two farm types. More labour is employed on Parmigiano-Reggiano farms of the same herd size. When only farms on the plains are compared the difference in labour intensity is apparently irrespective of herd size (Figure 10.12). However, if all dairy farms on the mountains and plains are taken together the differences are less pronounced, because the industrial dairy farms in the mountains have fewer opportunities to reduce labour input than those on the plains. In fact, Figure 10.13 shows a divergence between the two regression lines.

Table 10.14 Annual Working Units employed on PR dairy farms

	1-19 cows	20-49 cows	50-99 cows	➢ 100 ➢ cows	Total
Parma	2,295	2,402	1,800	1,833	8,330
Reggio Emilia	1,771	2,073	1,777	1,686	7,307
Modena	1,904	1,426	1,263	927	5,518
Total	5,970	5,900	4,839	4,447	21,154

The following procedure was followed in assessing the extra-employment generated by Parmigiano-Reggiano production on the dairy farms. First, the actual employment on Parmigiano-Reggiano dairy farms was

estimated on the basis of the linear regression in Figure 10.12 attributing the Annual Working Units (AWU) to the size classes indicated in table 10.14. In the provinces of Parma, Reggio Emilia and Modena a total of 21,154 AWU were employed on Parmigiano-Reggiano dairy farms.

It can be hypothesised, that without the Parmigiano-Reggiano production system the herd size distribution of all the dairy farms in the area would resemble the herd size distribution of the industrial dairy farms. Therefore, an estimate has been made of the cow distribution in the three provinces of the Parmigiano-Reggiano area assuming the herd size distribution of the industrial dairy farms. The labour requirements of the industrial farms in the different herd size classes were multiplied by the number of cows to emerge from the latter estimate. According to this calculation, without the PR production system, only 11,290 AWU would be able to find employment on the dairy farms.

Table 10.15 Annual Working Units on dairy farms in case of industrial milk production

	1-19 cows	20-49 cows	50-99 cows	100 cows	Total
Parma	0	57	229	3,618	3,904
Reggio Emilia	13	224	710	3,034	3,982
Modena	221	639	813	1,437	3,035
Total	332	1,230	2,193	7,642	11,290

From these calculations it would appear that the production of Parmigiano-Reggiano cheese leads to a doubling of employment on dairy farms. It should be stressed that part of this difference is due to the fact that there will be dairy farmers, particular older farmers working very small Parmigiano-Reggiano dairy farms, who do not have a high return for their labour. Despite this many of them continue to produce because they are driven by a passion for the product and a wish to be part of the production system. Such motivation is lacking among industrial dairy farmers, where the reasoning of economic convenience prevails. A comparison made of farms with less than 20 cows showed that on these farms employment opportunities would disappear almost entirely.
On medium- and large-sized dairy herds these differences in motivations are smaller and costs and returns are carefully monitored, but also in these size classes the differences in employment are significant. The Parmigiano-Reggiano system guarantees higher employment particularly on farms with herd sizes of 20-49 cows and 50-99 cows.

10.10 Collective performance of the supply chain

In order to estimate the collective performance of the Parmigiano Reggiano chain in terms of its benefits to the rural economy, a comparison has been made with dairy farming beyond the borders of the Parmigiano Reggiano production area. This include the provinces of Bologna to the east of the river Reno and the provinces of Ferrara, Forlì, Ravenna and western Piacenza. An analysis was made of data on agricultural land and bovine populations collected in the two census years 1982 and 1991 from the municipalities in these provinces. The Standard Gross Margins of the various agricultural activities carried out in these municipalities was also calculated. The results of these calculations have been presented in Table 10.16 and 10.17.

First, it is noteworthy that the cow/dairy cow/bovine population in the mountainous areas of Parmigiano-Reggiano production did not decline between 1982 and 1991. In fact, their numbers increased by about 5 percent. In neighbouring mountain areas, however, where the natural and pedological characteristics were quite similar, the cow population declined by 17 percent. Similar differences were also noted between those areas in the hills and plains that bordered on the Parmigiano Reggiano region and the Parmigiano Reggiano area itself.

Although the agricultural labour force is in decline in all the areas listed in Table 10.16, the rate of decline was slightly less in the mountains of the Parmigiano- Reggiano area. The amount of agriculture land in use in the Parmigiano-Reggiano region had not declined as much as similar land in neighbouring mountain areas. From these observations one may conclude that the Parmigiano-Reggiano production system has contributed significantly to rural development, especially in the less favoured part of the Parmigiano Reggiano region.

When an analysis is made of the Standard Gross Margin, which may be used as a rough income parameter, it becomes evident that there is a higher income level per Annual Working Unit within the Parmigiano Reggiano mountain areas than in the mountainous parts of neighbouring provinces. In 1981, this income difference was seven percent in favour of the Parmigiano-Reggiano area and in 1991 the positive income difference had grown to 27 percent. In the Apennine mountains there are very few alternative types of agricultural production, only roughage for ruminants such as milking cows, beef cows and sheep can be produced. The income difference of 27 percent for farmers in the Parmigiano Reggiano area explains why the cow population has not declined and why employment

levels have not suffered too much. In absolute terms the number of agricultural workers employed per 1000 hectares was 22 percent higher in the Parmigiano Reggiano mountain area in 1981 than in the mountain areas of the neighbouring provinces. In 1991 the difference was 16 percent.

Table 10.16 Comparison of structural indices within and outside the PR area

	PR production area			Bordering area		
	Mountains	Hills	Plains	Mountains	Hills	Plains
Number of municipalities	44	46	91	23	60	53
Milking cows 1982	48,283	70,306	207,263	13,893	35,255	43,057
Milking cows 1991	50,632	78,374	210,187	11,454	32,804	35,333
% variation of milking cows 1982-1991	4.9	11.5	1.4	-17.6	-7.0	-17.9
Agricultural labour force 1982 (AWU)	14,754	20,412	55,733	5,975	21,211	39,735
Agricultural labour force 1991 (AWU)	10,724	14,380	39,433	4,081	15,687	28,479
% variation labour force 1982-1991	-27.3	-29.6	-29.2	-31.7	-26.0	-28.3
Agricultural land area 1982 (ha)	135,314	127,971	308,473	67,114	172,697	201,353
Agricultural land area 1991 (ha)	122,445	125,452	302,234	54,430	164,085	202,270
% variation agr. land area 1982-1991	-9.5	-2.0	-2.0	-18.9	-5.0	0.5
Forage crop area 1982 (ha)	62,328	74,622	114,897	26,525	65,750	43,607
Forage crop area 1991 (ha)	57,447	76,058	103,980	22,426	56,909	37,084
% variation forage crop area 1982-1991	-7.8	1.9	-9.5	-15.5	-13.4	-15.0
Parameters						
Cow density 1982(cows per ha)	0.36	0.55	0.67	0.21	0.20	0.21
Cow density 1991(cows per ha)	0.41	0.62	0.70	0.21	0.20	0.17
Stocking rate 1982(cows per ha forage crops)	0.77	0.94	1.80	0.52	0.54	0.99
Stocking rate 1981(cows per ha forage crops)	0.88	1.03	2.02	0.51	0.58	0.95

Source: Own calculations on data ISTAT

A comparison of income and employment levels between the hill regions of the two area is complicated by the fact that, in these areas, many other agricultural activities, such as wine production can be undertaken. The hills are a more favourable environment for agriculture than the mountains. In the hills of the Parmigiano Reggiano region employment levels in 1981 was 29 percent higher than in neighbouring areas and in

1991 this difference was 20 percent. The incomes in the Parmigiano Reggiano hills are slightly lower than in the hills outside the Parmigiano Reggiano production area. Making a comparison between income levels in the plains is more complicated because in both Parmigiano Reggiano areas and non-Parmigiano Reggiano areas incomes derived from other agricultural activities interfere.

Table 10.17 Gross Standard Margin within and outside PR area (billion ITL 1982-1991)

	PR production area					
	Mountains		Hills		Plains	
	1981	1991	1981	1991	1981	1991
Number of municipalities	44	44	46	46	91	91
Arable farming	12.3	8.7	36.9	46.6	339.9	442.1
Orchards and vineyards	3.0	4.5	42.4	56.8	179.2	250.8
Animal production	72.4	97.9	131.7	157.6	490.3	545.8
Milk	44.7	66.1	72.1	100.9	234.2	275.3
Beef	15.5	17.0	27.3	26.5	118.6	127.1
Total	87.6	111.1	210.9	261.0	1.009.5	1.238.7
SGM per AWU (000 ITL)	5,947	10,360	10,332	18,150	18,113	31,413
Number of AWU/1000 ha	109	87	159	115	181	130
	Bordering area					
Number of municipalities	23	23	60	60	53	53
Arable farming	11.7	10.6	82.3	126.1	306.9	379.0
Orchards and vineyards	2.6	2.5	83.0	101.8	266.7	288.9
Animal production	18.9	20.1	81.5	86.9	104.2	123.0
Milk	10.4	9.2	32.1	30.9	46.6	40.8
Beef	7.1	5.9	30.5	22.0	35.4	29.3
Total	33.2	33.2	246.8	314.8	677.8	790.9
SGM per AWU (000 ITL)	5,556	8,130	11,635	20,067	31,955	50,417
Number of AWU/1000 ha	89	75	123	96	197	141

Source: Own calculations on data ISTAT and INEA

From the above analysis it can be seen that the Parmigiano Reggiano system is able to employ more agricultural labour in areas that are less favourable to farming than is possible in neighbouring areas with similar conditions. The possibility of earning higher agricultural incomes puts a brake on depopulation and favours the overall development of the mountainous parts of the Parmigiano Reggiano region. The production of Parmigiano-Reggiano cheese, therefore, makes an important contribution to the development of less favoured areas.

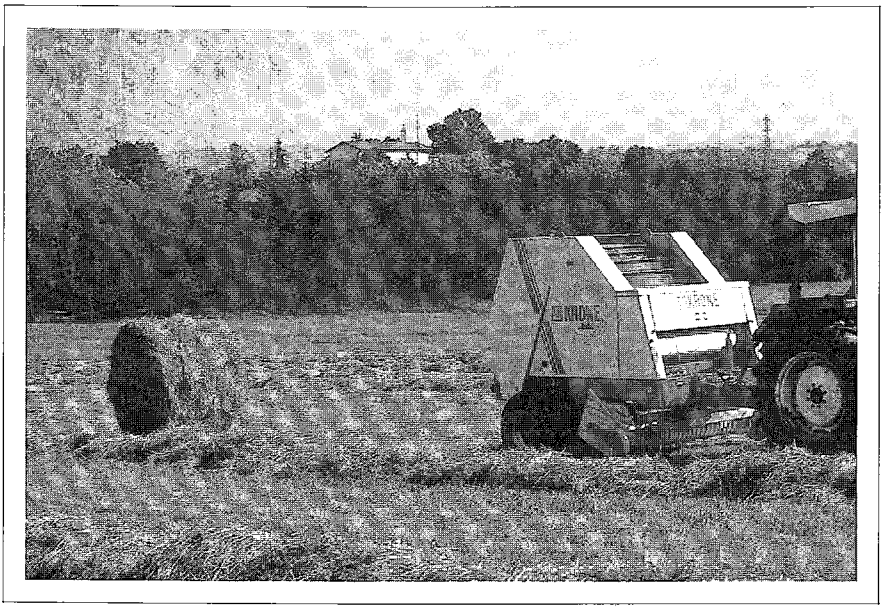
Notes

[1] As we have seen in Chapter 9 an important increase of labour productivity in the harvest and direct administering of green roughage has been obtained by the introduction of the self propelled grass harvester developed by the local small scale machinery industry.

[2] For single dairy cows the transition period is about two months, but before the herd used to produce industrial milk may start to produce milk for PR cheese it has to pass at least a transition period of six months.

[3] A large part of the results of this questionnaire has been discussed in the previous chapter.

[4] As has been explained in paragraph 7.3 this contribution complements the overall EU policy for dairy products. As in Italy Parmigiano-Reggiano and Grana Padano cheese represent about 35 percent of Italian milk production and the production of butter and whey powder is not significant in comparison with the other EU member states, the EU decided already in 1968 with the advent of the EU dairy policy to introduce special measures for the Italian dairy market. Intervention prices for PR cheese have been abolished in 1994, but the contribution to the storage of cheese remained, although its entity is declining gradually.



11 The Eco-Compatibility of the PR System

11.1 Introduction

In this last chapter of our study we will examine the nitrogen balance on Parmigiano Reggiano dairy farms more closely. In doing so we will attempt to answer a number of questions. First, how much more eco-compatible is the Parmigiano Reggiano dairy farm than the industrial dairy farm? Second, independent of the destination of the milk, what factors influence the nitrogen balance of dairy farms in general?

After a brief description of the methodology used in carrying out environmental auditing techniques, the economic and structural characteristics of the farms in question will be described in more detail. The results of the nitrogen balance analysis will then be examined in relation to the altitude zone (plains or mountains), the type of cow-shed, milk yield per cow and the size of the farm. A multi-variate analysis, based on a principal component analysis and followed by a multiple regression analysis, will be used to determine which factor has the greatest influence on the level of nitrogen surplus in the dairy farms concerned.

11.2. Methodology

In adopting the methodology needed to assess a farm mineral balance, the techniques already used in previous published research in this area (CLM *et. al.* 1992; Brouwer *et.al.* 1994; Schleef and Kleinhanss 1993) were taken into account. Consistent with the principles of these earlier studies, a methodology was developed that took account of the specific nature of farming in Emilia Romagna (De Roest and Fornacari 1995). The data used are drawn from three distinct sources.

1 Accountancy data drawn from the Regional Accountancy Network of the Emilia-Romagna region.
2 Technical data collected using a questionnaire

3 Various sources from literature. These sources have been used primarily to help create parameters on which analytical estimates can then be based. The farm questionnaire provided the data needed to identify how chemical and organic fertilisers were being used on the farms.

A survey was made of a group of 179 specialised dairy farms (These farms belong to the FADN Technical-Economic Orientation 41). Table 11.1 gives a detailed distribution of these farms in terms of the end use of the milk produced and the altitude at which they are situated.

Table 11.1 The farm sample

	Mountains		Hills		Plain		Sample	
Destination of milk	Farms	%	Farms	%	Farms	%	Farms	%
Parmigiano Reggiano	54	85.7	42	80.8	55	85.9	151	84.4
Industrial milk	9	14.3	10	19.2	9	14.1	28	15.6
TOTAL SAMPLE	63	100.0	52	100.0	64	100.0	179	100.0

Source: Own calculations

Table 11. 2 Characteristics of the farm sample

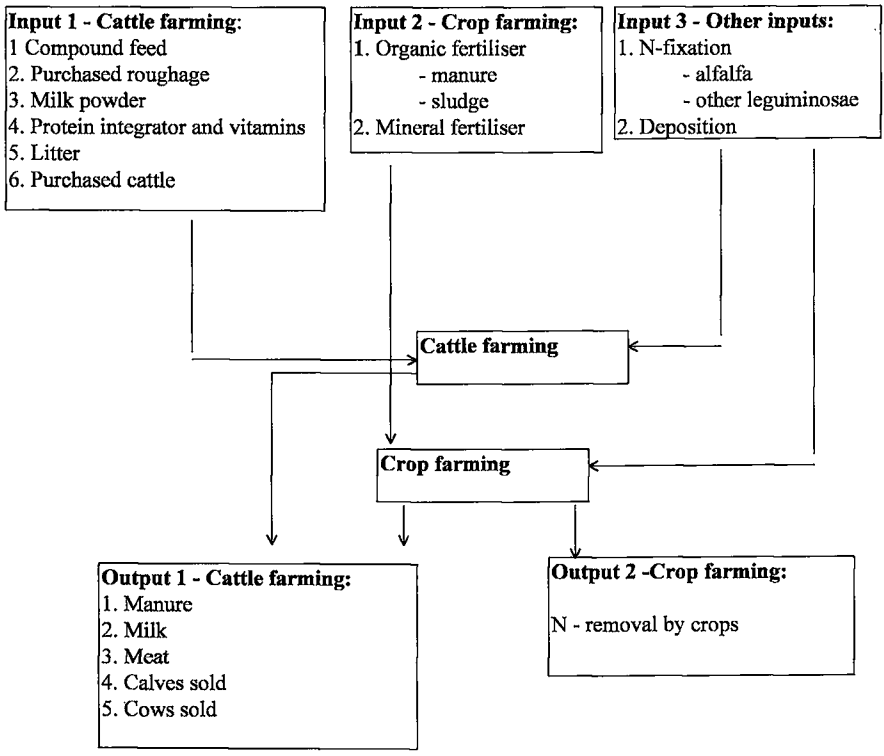
	Parmigiano Reggiano farms			Industrial dairy farms		
	Mount. 54 cases	Hills 42 cases	Plain 55 cases	Mount. 9 cases	Hills 10 cases	Plain 9 cases
1- Division of crops						
Cultivated land area (in ha)	27.8	30.2	23.7	29.3	30.3	36.1
% forage crops	95.2	87.9	85.7	83.2	76.7	82.3
2-Herd Size and Working Force						
Number of milking cows	26.0	31.6	41.8	18.4	33.2	71.5
Cows per hectare of forage area	1.1	1.3	2.2	1.0	1.6	2.4
Hours per cow per year	192	173	145	180	149	92
3-Efficiency and intensity						
Kg milk per forage hectare	5,352	6,970	13,373	3,952	7,811	15,168
Forage Maize Yields (tons hectare)	3.74	16.90	28.61	13.60	19.67	55.09
Alfalfa yields (tons hectare)	5.70	7.22	10.86	6.04	7.60	9.33
Milk yields per cow (kg/cow)	4,800	5,130	6,130	3,730	4,210	6,.200
Kg. milk per kg. Feed	2.25	2.44	2.56	3.83	3.16	3.01
4-milk cost and management results						
Gross Margin/Annual Woking Unit (mlns ITL)	27.9	34.8	48.0	20.2	39.2	55.0
Net income per family worker (millions ITL)	20.5	24.2	38.2	10.2	45.5	63.7

The specialised nature of the dairy farms shown in Table 11.2 is typical of the area under consideration: medium-sized livestock and forage producing farms. The percentage of cultivated land devoted to the forage crops is never less than 75 percent and in the most extreme cases it can be

as much as 95 percent. The herd size varies between 18 and 26 cows in the Appennine mountains and between 41 and 72 cows on the plain. The intensity of the land use, measured in heads of cattle per hectare of forage crops ranges from 1.1 to 2.2 cows per hectare in the Parmigiano Reggiano group and from one to 2.4 cows per hectare on the industrial dairy farms. The annual milk yield per cow ranges between 4,800 and 6,100 kg in the Parmigiano Reggiano group and between 3,700 and 6,200 kg on the industrial dairy farms.

In making the calculations needed to assess the nitrogen balance, the flow diagram (Figure 1) shows 13 input headings and seven output headings. The difference between input and output represents the nitrogen balance.

Figure 11.1 Diagram of nitrogen inputs and outputs for dairy farms



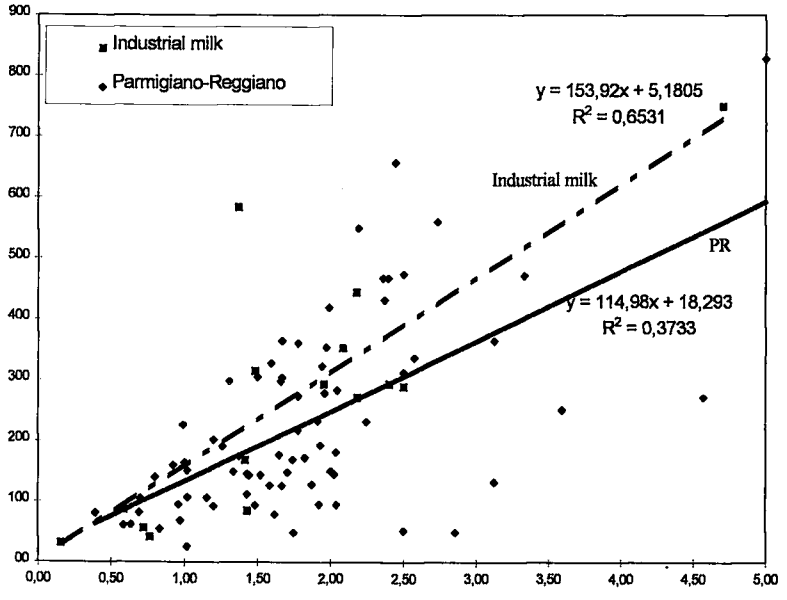
Source : CLM *et. al.* (1992)

11.3 Farm nitrogen balance and intensity of land use

The greatest problem with intensive farming techniques is that they break the mineral cycle on the farm. The continuous increase in the animal-to-hectare ratio, caused by the increases in the price of land, has raised the level of mineral inputs. The loss of nitrogen in the form of ammonia, N_2O and nitrates are a product of this development in livestock farming. There is a close relationship between the total nitrogen surplus of the farm and stocking rates, measured by the number of heads of cattle per hectare. The nitrogen surplus derived from the nitrogen balance calculations represents the farm's total nitrogen losses irrespective of the form they take.

The following figure indicates the relationship between the nitrogen surplus per hectare and the number of cows per hectare of cultivated land. The linear regression coefficients are statistically significant ($P < 0.05$) - proof of the close link between the two variables. The variability around the regression line is particularly interesting because it indicates that at a certain stocking rate still significant differences in the nitrogen balance may occur. Dairy farmers have thus a substantial margin for improving their N-balance.

Figure 11.2 Nitrogen surplus per hectare according to cow density and milk destination - plain farms



11.4 Farm nitrogen balance, altitude level and milk destination

A second analysis of differences in the farm nitrogen balances was designed to identify the importance of the farm's topological location and whether the milk was used for Parmigiano Reggiano cheese or for industrial purposes. There is a marked difference in the nitrogen surpluses produced by farms on the plain and farms in the mountains (Table 11. 3). The nitrogen surpluses produced by mountain farms varies from 48 to 122 kg of nitrogen per hectare. In contrast, on the plains, surpluses range from 230 kg to 309 kg per hectare. These differences in nitrogen surplus can be explained by a higher stocking rate and higher levels of productivity on plain farms than on mountain farms. It is no surprise to find that farms on the plain exert more pressure on their environment than farms in the mountains.
It is interesting to compare farms working within the Parmigiano Reggiano system with industrial dairy farms (see Table 11.3 and 11.4 and again figure 11.2). The comparison only involved the farms on the plain in order to eliminate the effect of different altitude zones.

Table 11.3 Inputs and outputs of nitrogen in dairy Parmigiano-Reggiano dairy farms

	Mountains 54 cases		Hills 42 cases		Plain 55 cases	
	kg/ha	%	kg/ha	%	Kg/ha	%
Purchased feed	66.65	43.6	81.54	40.5	131.60	40.7
Purchased roughage	27.12	17.7	40.86	20.3	85.20	26.3
Purchase of organic fertiliser	6.04	3.9	12.79	6.3	22.17	6.8
Chemical fertiliser	9.12	6.0	21.89	10.9	35.72	11.0
Atmospheric deposition	18.30	12.0	18.30	9.1	17.63	5.4
Purchase of young beef stock	1.26	0.8	0.34	0.2	0.72	0.2
Purchase of milk powder	1.20	0.8	0.77	0.4	1.16	0.4
Litter	2.52	1.6	3.39	1.7	6.99	2.2
N-fixing by leguminous crops1)	20.80	13.6	21.59	10.7	22.48	6.9
TOTAL INPUTS	153.02	100	201.45	100	323.68	100
Sales of organic manure	1.19	3.9	3.92	7.8	8.57	10.2
Milk sold	23.77	77.1	32.66	64.6	54.33	64.6
Cows sold	3.14	11.2	4.78	9.5	7.22	8.6
Calves sold	0.51	1.7	0.94	1.9	1.20	1.4
Meat Sold	3.95	12.8	5.72	11.3	8.41	10.0
N-removal by non legum. Crops	1.91	6.2	8.23	16.3	12.77	15.2
TOTAL OUTPUTS	30.83	100	50.53	100	84.08	100
Nitrogen surplus	122.19		150.92		239.60	

It appeared that Parmigiano Reggiano farms on the plain show a total nitrogen loss of 239 kilograms of nitrogen per hectare. Industrial dairy

farms, by contrast, show a loss of 309 kilograms per hectare – a difference in the order of almost 30 percent. If one considers that the number of cows per hectare on industrial dairy farms is only 10 percent more than on Parmigiano Reggiano farms, and that milk yields per cow are almost identical in two groups, a substantial part of the difference in nitrogen surpluses has to be attributed to the different farming system. Figure 11.2 shows that the slope of the linear regression line is less steep for the PR farmers than for the dairy farmers producing industrial milk.

If the composition of the nitrogen balance is examined in more detail, it becomes clear that the industrial farms use more purchased feeds and mineral fertilisers per hectare. This reflects a crucial difference between the two farming types as far as cattle feeding regimes are concerned. Another difference between the two farming types is the nutrient ratios for the different crops. The fertilisers coming into the farm (whether organic or chemical in nature) represent 18 percent of the total nitrogen input in the Parmigiano Reggiano balance. In the industrial dairy farms this is 23 percent. This can be explained by the fact that Parmigiano Reggiano group's requirements for nitrogenous substances is reduced because farmers use N-fixing alfalfa in their cropping pattern. Industrial dairy farms, however, concentrate more on growing graminaceous and maize crops for silage and apply mineral fertilisers to do so.

Table 11.4 Inputs and outputs of nitrogen in industrial dairy farms

	Mountains 9 cases		Hills 10 cases		Plains 9 cases	
	Kg/ha	%	kg/ha	%	Kg/ha	%
Purchased feed	19.56	27.8	70.39	44.1	189.88	47.1
Purchased roughage	6.00	8.5	16.89	10.6	82.45	20.4
Purchase of organic fertiliser	1.65	2.3	3.01	1.9	0.00	0.0
Chemical fertiliser	5.90	8.4	37.50	23.5	93.09	23.1
Atmospheric deposition	18.30	26.0	18.30	11.5	18.30	4.5
Purchase of young beef stock	0.22	0.3	0.04	0.0	0.62	0.2
Purchase of milk powder	0.59	0.8	0.74	0.5	1.78	0.4
Litter	0.75	1.1	1.08	0.7	2.45	0.6
N-fixing by leguminous crops 1)	17.32	24.6	11.80	7.4	14.68	3.6
TOTAL INPUTS	70.29	100	159.76	100	403.25	100
Sales of organic manure	0.00	0.0	0.00	0.0	0.00	0.0
Milk sold	12.89	58.1	27.01	59.6	62.33	66.3
Cows sold	1.84	8.3	3.33	7.3	8.06	8.6
Calves sold	0.44	2.0	0.87	1.9	1.54	1.6
Meat Sold	2.28	10.3	4.20	9.3	9.60	10.2
N-removal by non legum. Crops	7.00	31.6	14.10	31.1	22.11	23.5
TOTAL OUTPUTS	22.17	100	45.31	100	94.04	100
Nitrogen surplus	48.12		114.44		309.20	

1) N-Fixation, net of removal Source: Own calculations

It can, therefore, be said that Parmigiano Reggiano dairy farms, on average, use nitrogen more efficiently than those farms that are not bound to follow Parmigiano Reggiano production regulations. Figure 11.2 shows this clearly. As stocking rates increase, industrial dairy farms are faced with a more rapid deterioration of nitrogen surpluses per hectare than the dairy farms that produce milk for Parmigiano-Reggiano cheese.

11.5 Nitrogen balance and intensity of milk production

Table 11.5 sets out details of the nitrogen balances for different groups of farms classified according to their level of productivity. It can be seen that the nitrogen surpluses show a progressive increase over the first three yield categories and flatten out in the last. Taking the lowest productivity group of farms producing up to 4,000 kg of milk per cow per year, the nitrogen surplus per hectare in this farms is 188 kilograms. A maximum surplus of 292 kilograms of nitrogen per hectare is generated by the group of farms where yields are between 5,000 and 6,000 kg per cow. The increase of nitrogen inputs in the form of feed concentrates and forage crops is not correlated to herd productivity. This is probably due to the fact that the number of cows per hectare for the high production farms is less than for farms whose herds give a smaller yield. The total input of nitrogen per hectare in the form of feed for the less productive group is 160 kilograms while the equivalent figure for the two middle categories is between 260 and 270 kilograms. The figure for farms with the highest unit productivity is 247 kilograms. The proportion of total inputs represented by feed is therefore much the same between the various productivity categories, and is in any case, never less than 40 percent.

The conclusion to be drawn from the positive correlation between average cow productivity and the size of the nitrogen surplus is that those farms with higher milk yields are more likely to experience environmental problems. The farms with higher unit yields are less efficient in their use of nitrogen. Another indication of this relationship is obtained through the ratio of nitrogen surplus per ton of milk produced. Figure 11.3 shows that the inputs and outputs per ton of milk increase with increased unit yields, but on balance no significant differences between the milk yield groups is apparent. In the next paragraph, the impact of milk yield on the nitrogen surplus, independant of other factors, will be assessed.

Figure 11.3 Nitrogen balance per ton of milk according to milk intensity levels per cow – Plains

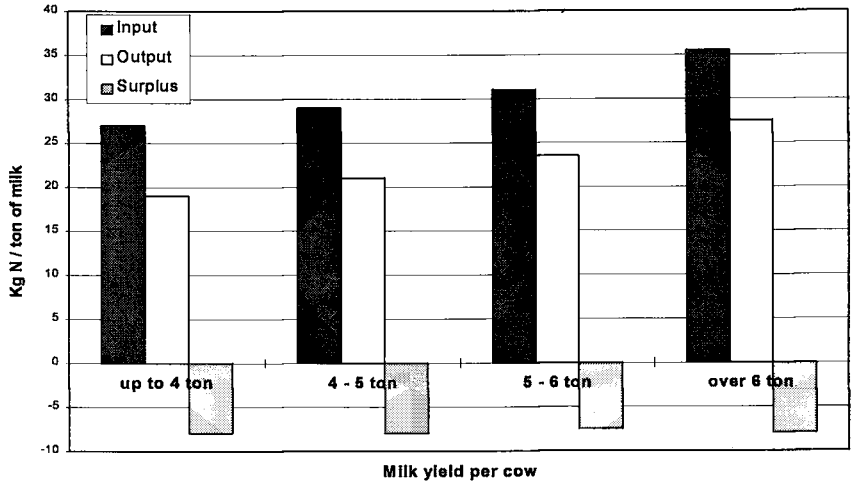


Table 11.5 Inputs and outputs of nitrogen by classes of milk production per cow – Plains

	Milk production per cow							
	Up to 4,000 kg 23 farms		4,000-5,000 kg 13 farms		5,000-6,000 kg 7 farms		Over 6,000 kg 21 farms	
	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
Purchased feed	117.44	43.1	151.26	41.3	164.73	44.4	148.86	40.0
Purchased roughage	51.88	19.1	117.49	32.1	96.07	25.9	96.90	26.1
Purchase of organic fertiliser	18.17	6.7	7.98	2.2	18.11	4.9	27.20	7.3
Chemical fertiliser	36.70	13.5	42.58	11.6	40.41	10.9	53.44	14.4
Atmospheric deposition	18.30	6.7	16.89	4.6	15.69	4.2	18.30	4.9
Purchase of young beef stock	0.63	0.2	0.87	0.2	1.30	0.4	0.49	0.1
Purchase of milk powder	1.15	0.4	0.88	0.2	1.96	0.5	1.34	0.4
Litter	5.88	2.2	6.24	1.7	9.11	2.5	6.01	1.6
N-fixing by legum. crops 1)	22.07	8.1	22.31	6.1	23.52	6.3	19.35	5.2
TOTAL INPUTS	272.22	100.0	366.50	100.0	370.90	100.0	371.89	100.0
Sales of organic manure	11.18	13.3	1.89	1.9	0.47	0.6	8.89	11.0
Milk sold	48.77	57.9	71.31	72.0	54.70	69.4	53.20	66.0
Cows sold	6.63	7.9	8.39	8.5	7.65	9.7	7.36	9.1
Calves sold	1.05	1.2	1.63	1.6	1.27	1.6	1.21	1.5
Meat Sold	7.68	9.1	10.01	10.1	8.92	11.3	8.57	10.6
N-removal by non legum. Crops	16.65	19.8	15.81	16.0	14.77	18.7	9.97	12.4
TOTAL OUTPUTS	84.27	100.0	99.03	100.0	78.85	100.0	80.63	100.0
Nitrogen balance	187.95		267.47		292.05		291.26	

11.6 Interrelations between technical efficiency, farm structure and nitrogen balance

A principal component analysis was carried out on indicators chosen as being the most representative of all those available. This was done in order to highlight relations between nitrogen surplus generation and the structure, technical characteristics and income generating capacity of the farms concerned. In this analysis it was necessary to neutralise variations caused by farm altitude and the end use of milk which has been analysed above. Thus, the analysis was carried out only using data from the 55 farms on the plain whose milk went into Parmigiano Reggiano production.

Thirteen of the most representative variables were chosen and it was ascertained that the data were suitable for use in the analysis (the nil hypothesis of even distribution could not be rejected). A factor analysis was then carried out on the basis of a methodology that focuses on the extraction of the principal components.
The four factors obtained in this way explain 82 percent of the variance in the variables. All values less than the threshold value of 0.5 were deleted to provide an easier reading of the results obtained in the rotated factorial weight matrix (using Varimax rotation criteria). The weight of the respective factors, as set out in Table 11.7, gives a clear picture of the relative significance of the four factors obtained.

Table 11.7 Matrix of rotated factors- Plain

Description of variables	Variable	Factor 1 STRUTT	Factor 2 INTLAT	Factor 3 SPECIAL	Factor 4 INTFOR
Utilised Agricultural Area (UAA)	SAUC	0.84564			
Number of cows	VACTR	0.88065			
Hours worked per cow	ORESVAC	-0.86396			
Cows per Working Unit	VACULS	0.84011			
Average yields per cow	RESUTR		0.85493		
Kg. of milk per kg.of concentrate	LATMANC		-0.84956		
Cost of concentrates per cow	CMANVAC		0.95802		
Forage % of UAA	INCFOR			0.90935	
Alfalfa % of UAA	INCMED			0.91674	
Gross value of beef cattle in %	SPECPLV			0.71548	
Kg. of Milk per forage Hectare	LATFOR				0.80406
Cows per forage hectare	VACFOR				0.90594
Cost of forage per cow	CFORVAC				0.69881
% Variation explained by FACTOR		26.9	24.3	18.1	12.8

Source : Own calculations

1 The first factor contains all the main size variables introduced at the beginning. The variation explained by this factor is 27.9 percent of the

total. The main correlated variables are: average herd size (VACTR), labour productivity (ORESVAC, VACLS), and farm size (SAUC). For this reason the factor can be defined as **Size** (STRUTT).

2 The second factor, accounting for 24.3 percent of the variation, is an amalgamation of all indicators used to measure the production intensity of the farm. The following variables are of particular relevance in this respect: average productivity of the cows (RESUTR), the production of milk per unit of feed purchased (LATMANC), and another variable closely linked to herd productivity - the cost of feed per cow (CMANVAC). This second factor has thus been called **Milk Production Intensity** (INTLAT).

3 The third factor encompasses all those characteristics that could be said to be typical of specialised dairy farm production. It accounts for 18.1 percent of the total variation. Within this factor the following variables are of particular importance: the proportion of cultivated land devoted to forage crops (INCFOR) and alfalfa (INCMED), together with the economic index of milk specialisation (SPECLPV). It was thus decided that the most appropriate name for this factor was **Milk Specialisation** (SPECIAL).

4 The fourth factor accounts for 12.8 percent of the total variation. This includes all three indicators concerned with land use intensity: the ratio of cattle population amount of land under forage crops (LATFOR), milk production per hectare of forage crops (latfor), and finally, the cost per cow of forage not produced on the farm. The name given to this factor was **Land Use Intensity** (INTFOR).

These calculations were used as a basis for the second stage of the analysis. The factors obtained as independent variables were used to calculate, through multiple regression, relations with the dependent variable of surplus nitrogen per hectare. The multiple regression calculations were carried out using the Stepwise method.

The main result to emerge from this analysis was that all four factors were included in the regression equation. They were ordered within the model in accordance with their degree of correlation, whether simple or partial, with the dependent variable. The resultant ranking of factors was as follows: land use intensity; intensity of milk production; size, and lastly, milk specialisation. It can be seen that the value of R^2 changes from 0.42 to 0.51 and 0.57 for the third factor. Its final value is 0.63 when all four factors are included in the model. This means that 63 percent of the variation in surplus nitrogen per hectare can be explained by the model. The multiple regression equation explaning the variance in the nitrogen surplus per hectare is the following:

$$\underset{}{} \quad \underset{(F3)}{} \quad \underset{(F2)}{} \quad \underset{(F4)}{} \quad \underset{(F1)}{}$$
$$BILAN\_N = 239{,}6 + 0{,}245STRUTT + 0{,}29INTLAT + 0{,}244SPECIAL + 0{,}649INTFOR$$
$$\underset{(2{,}830)^*}{} \quad \underset{(3{,}356)^*}{} \quad \underset{(2{,}815)^*}{} \quad \underset{(7{,}493)^*}{}$$
$$R^2 = 0{,}62503^{**}$$

* Valori T Student significant at 99 percent.

42 percent of the variation in the dependent variables in the model can be accounted for by the fourth factor. Land use intensity is the crucial variable when we try to reach an understanding of the problem of nitrogen within specialist dairy farms.

An increase in soil use intensity may be the result of pressure on the farm to exploit its land resources more fully. This involves the problem of producing nitrogen surpluses. These problems may become evident in the growth in nitrogen inputs and in relation to output levels.

As far as inputs are concerned, the increase in surpluses due to the use of more intensive farming techniques may take the following forms:

1. A greater increase in forage purchased from outside the farm when cattle requirements exceed internal supply of forage crops;
2. A greater input of chemical fertilisers if the farmer decides to force forage crop growth in order to increase self-sufficiency in forage production.

As far as outputs are concerned, increases as a result of a more intensified use of farming techniques may be manifested in the reduction of available land per head of cattle for slurry spreading, leading to problems of effluent disposal.

Of greater interest is the influence of the other three factors in the model. This is because they are included in the model independent of the factor of land use intensity. In the first place, farms that put the most emphasis on herd productivity (the INTLAT factor) generate heavier nitrogen losses than less intensive farms. While this relationship has already been identified in the findings of the bivariate analysis carried out above, here it has been 'purified' of the effects exerted by the other factors. As cow milk yields rise, the uncontrollable nitrogen loss factor increases and hence the efficiency of nitrogen use declines.

The large dairy farms are also less efficient in their use of the mineral nitrogen. This may be the result of reduced precision in the on-farm utilisation of feed and fertilisers. It is reasonable to assume that as the size

of the farm increases there is a corresponding reduction in the amount of attention given to the use of resources.
Finally, results show that those farms that have the greatest degree of specialisation in dairy production generate heavier nitrogen imbalances than less specialised farms. This may be due to the fact that the way nitrogen is used in arable farming is more efficient than the way it is used in livestock production. There are many opportunities for wasting nitrogen in livestock farms including the concentration of ammonia in the cow-sheds and during manure spreading activities. Nitrogen losses are less in crop production.

11.7 Economic efficiency and eco-compatibility

The scores obtained from the factor analysis make it possible to allocate each of the 55 farms in the sample to one of three groups. These groups comprise farms with low, medium and high factor scores. To do this, the four factors obtained were separated into three groups on the bases of percentage scores. The percentage range was fixed in such a way as to create three equal groups (or as near equal as the numbers in the sample would allow). Using these categories, the main indicators available were re-calculated to make it possible to analyse the inter-dependence of the following factors: farm size, environmental pressure and economic efficiency.
Before going on to a more detailed analysis of Table 11.8 it is interesting to note the findings in relation to nitrogen surpluses. The excess nitrogen per hectare for farms in the group with the lowest levels is most strongly linked to the factor of land use intensity. The surplus values in the highest group are more than double those found in the lowest group - 332 kg/ha as opposed to 152 kg/ha. The remaining factors are set out in order of importance: size (increase of 79.2 percent), intensity of milk production (increase of 55.4 percent) and finally, specialisation (increase of 36.8 percent).

If the findings are then expressed in terms of nitrogen surplus per ton of milk produced, it appears that the factor with the greatest correlation to the farm groupings is that of size. The fourth and third factors follow in order of importance. There is no correlation apparent between nitrogen surplus per ton of milk and the degree of farm specialisation in dairy production.

Three variables were introduced to assess the economic efficiency of the farms. These were gross margins per annual working unit, net income per family member working on the farm, and milk production cost. The

clearest finding is that of a strong correlation between both net income and milk production costs and size. Net income per working family member ranges from income levels of ITL 24.8 million for the smaller farm category to ITL 52.1million for the large farm category. The variation in milk production costs is also greatest in relation to this factor. There is a strongly negative correlation - production costs for one kilogram of milk in the lowest category amounts to ITL 716 as compared to ITL 672 in the highest category (-7.5 percent).

The results also indicate that greater specialisation in dairy production can result in higher net income levels. It should be emphasised though, that the relationship here is much less strongly marked. The economic efficiency variables do not show any correlation either with milk production intensity or land use intensity. These are however, the factors that account for the greater part of variations in nitrogen surplus per hectare. An important conclusion can be drawn from the findings of this analysis: the most intensive farms generate the greatest environmental problems as a result of the way they use their land and produce milk. At the same time it cannot be said that they are more efficient in economic terms. Farms that have high levels of milk productivity also experience a decline in the technical efficiency of their production because of a reduced ability to control mineral flows. In turn this leads to a reduction in production efficiency. Those farms increasing the ratio of cattle to land beyond certain limits experience a disproportionate increase in costs when they purchase forage, feed concentrates and fertilisers. As a result they become caught in a cycle where resources are used less efficiently and nitrogen losses increase. The figures in Table 11.8 indicate that farms with high cattle to land ratios generate levels of nitrogen surplus that are 219 percent higher than the levels generated by farms with lower cattle to land ratios, but in the latter group the net income per working family member is only 9 percent lower. Reducing the effects of a farm's negative impact on its environment need not necessarily involve negative consequences for its income generating capacity.

The results referred to above show how different styles of farming have very different consequences for the environment. Highly relevant is the fact that better environmental results can be obtained without a significant decrease in income. Although PR farms already exert less pressure on the environment than industrial farms, results could be even better if local agricultural policy puts more emphasis on improving the environment by using farm mineral balances on the farm as a tool for the quantification of inputs and outputs of nitrogen. With farm mineral balances farmers may act to reduce the N-surplus there where evident excess use is taking place.

This specific political issue goes however beyond the objectives of this thesis.

Table 11.8 Structural, environmental and economic indicators per factor

Unit of Measure		FACTOR 1 SIZE			FACTOR 2 INT. MILK PR.			FACTOR 3 DAIRY SPEC.			FACTOR 4 LAND USE INT.		
		Low	Mediu m	High	Low	Mediu m	High	Low	Mediu m	High	Low	Mediu m	High
Number of farms		18	19	18	18	19	18	18	19	18	18	19	18
Crop Division													
Cultivable Land total	hectares	11.6	22.8	36.8	21.5	22.2	27.6	27.2	22.0	22.0	30.3	22.0	19.0
% forage crops	%	83.2	87.8	86.1	80.9	90.7	85.3	75.9	85.2	96.1	86.5	85.9	84.7
- % alfalfa in Forage	%	79.8	82.2	81.9	77.5	87.3	78.9	70.9	79.8	93.3	82.9	82.3	78.7
Herd size and work													
Cows	Head	19.6	42.8	62.9	37.2	41.4	46.8	42.6	41.0	41.7	43.1	38.3	44.1
Cows per worker	Head	12.2	17.0	23.8	19.7	17.4	15.9	18.1	17.0	18.0	16.6	18.0	18.3
Efficiency													
Milk per forage hectare	ton.	13.2	13.4	13.4	11.6	12.9	15.7	13.4	14.2	12.4	10.7	12.4	17.1
Cows per forage hectare		2.2	2.2	2.1	2.2	2.2	2.2	2.3	2.2	2.0	1.7	2.1	2.8
Forage maize yield	qls/ha	204.9	310.4	341.9	356.5	233.1	271.8	319.4	329.0	207.7	234.3	273.5	351.3
Alfalfa yeield	qls/ha	99.0	114.2	112.2	116.5	109.9	99.2	113.8	112.9	98.8	104.0	106.1	115.8
Milk yield per cow	qls/year	60.9	59.7	63.5	53.5	59.6	71.1	58.7	63.3	61.9	62.0	60.3	61.8
Economic Data & Management results													
Gross margins per Working Unit	millions of lira	33.2	46.4	64.4	50.2	46.0	47.8	45.0	48.4	50.5	45.0	49.2	49.6
Net income per Family Working Unit	million of lira £	24.8	37.6	52.1	40.2	37.0	37.3	34.1	38.0	42.7	34.0	41.5	39.0
Mineral BALANCES													
Surplus N per Hectare	Kg./ha	174.2	232.9	312.1	169.5	283.5	263.4	196.2	253.3	268.5	152.1	234.7	332.3
Index N/ha surplus (Low =100)	index	100.0	133.7	179.2	100.0	167.8	155.9	100.0	128.7	136.4	100.0	154.8	219.1
Surplus N per ton of milk	Kilogram./ton of milk	17.2	22.2	28.4	20.6	25.5	21.6	21.3	21.7	24.9	19.8	20.9	27.2
Index of surplus N /ton of milk (Low=100)	indice	100	128.8	164.7	120	123.2	104.4	100	101.4	116.3	100.0	105.3	137.4

Source: Own calculations

12 Conclusions

In many respects the Parmigiano-Reggiano production system is a unique dairy system. The processing of 1.35 million tons of milk into a high quality product in 600 small cheese dairies using predominantly artisan production techniques is unique in Europe. The high labour input required both on the dairy farms and in the cheese dairies creates considerably more employment than any other dairy system. About 20,000 men and women work everyday in this very special production system. In an industrial dairy system producing the same quantity of milk, no more than 8,000 people would be employed (Van der Ploeg 1994). The final quality of the cheese is heavily dependant on the ability of the cheese-maker to process the different qualities of raw milk which varies from season to season and from farm to farm, without using any additive, except for the dairy-based whey starter and rennet.

In an industrial dairy system milk is the raw material for a wide range of dairy products, all of which are the result of a combination of technological processes and additives and the latest bio-chemical research. Quality in the industrial system is something added at the end of the process. The central question addressed in this study was: Given the fact that most dairy systems widespread throughout Europe have adopted industrial production techniques, how has the Parmigiano Reggiano systems been able to maintain the use of artisan, labour intensive techniques? Why has this system not industrialised, like all the ancient cheese production systems in many other countries?

As I have shown in the introduction to this study, the answer to these questions has to be found by using theories that go beyond the liberal atomistic conception of the profit maximising 'homo economicus'. His behaviour can only be understood when his institutional and social context is taken into account. The problem is that notions such as loyalty, commitment, trust and a sense of belonging do not easily fit into economic concepts (Sauvée 1995). This contains contemporarily though a drive

towards the use of concepts on the behaviour of the actors which go beyond the mere economic variables.
The theory on economic districts contains a considerable interpretative power when it comes to understanding the reasons for the economic validity and persistence of the Parmigiano-Reggiano system. The integration of positive externalities generated within the district into a firm balance alleviates the higher costs generated by limited economies of scale such as we have noted in respect of milk production and processing and in the cheese maturing firms. In the peripheral zones of the Parmigiano Reggiano production area, where the network of cheese dairies is less dense the tendency to resist during periods of price crises is weaker than in the areas with a high concentration of cheese dairies. Here, a dairy farm will be more likely to close down. There is neither the density of farms or cheese dairies sufficient to create a system of common shared values about how milk should be produced or a common sense of belonging to the Parmigiano Reggiano system. These common values and a sense of belonging are very strong in the central zones of the Parmigiano Reggiano production area[1].
Within these areas information on the market prices of PR cheese, new technologies and compliance with the regulations covering the production (mutual social control) circulates intensely. The consciousness of belonging to the PR system and of sharing this common culture is the primary force that ensures the continuity of the system.

The small-scale co-operative structure of the cheese dairies is particularly important to the strength of the system. The strong integration of milk production and milk processing significantly reduces the transaction costs in this link of the Parmigiano -Reggiano system. Mutual trust and loyalty to the cheese dairy on the part of its members are the basic forces that hold this social organisation together. It is not only the co-operative structure itself, its limited scale that explains the continuity of the system. Enlarging the scale of the cheese dairies and effecting mergers with other dairies are subjects that always generate fierce debate. They not only involve the clash of two political worlds, but there is also the fear that such changes might have a detrimental effect on the final quality of the cheese. The fact that the cheese-maker must exercise control over key operations within the production process is regarded as a prerequisite for the quality of the cheese and puts a brake on any development towards large-scale processing units. It is interesting in this respect that the private cheese dairies, that are in the minority, also behave in the same way. Although they are private entrepreneurs buying their own milk and producing their own Parmigiano Reggiano cheese, these dairies are similar in size to the co-operative dairies and they have a similar and stable number of milk suppliers.

Many cheese dairies have market relations with only one or two cheese maturing firms and these too do not change much over time. Although many improvements may take place in this market relationship to the benefit of the cheese dairies, the stability of sales to a few purchasers guarantees a high reliability and this in turn reduces transaction costs.

A third important pillar of the PR system is the family farm structure that characterises the majority of PR dairy farms. These types of farm have lower monetary costs than farms that rely primarily on hired labour. Moreover, many dairy farms follow a style of farming that foresees a low integration into input markets, a factor that contributes even more to reducing monetary costs. The low proportion of monetary costs within total production costs enable many farms to survive periods of price crises. Even though the temptation to produce industrial milk is high during these periods, they will continue to produce milk for PR cheese. This is because deterioration's in the input/output price ratio does not penetrate their farm management decisions to the same extent it penetrates the decisions of farms that are more dependent on market price fluctuations. Dairy farmers that belong to the PR system are conscious of these strong price variations. During periods of high prices, which may exceed industrial milk prices by 30-40 percent, investments are made in new cowsheds, machinery and equipment. On average the deflated average price for PR milk over an eight-year period is similar to the deflated average industrial milk price, but the PR price remunerates a much higher labour input than the industrial milk price. In their management decisions PR dairy farmers take into account the long-term economic efficiency of their farms and are prepared to balance out periods of high prices with periods of low prices.

The fourth factor that contributes to the uniqueness of the PR system is institutional involvement. Local research centres, representative bodies and the public administration direct the specific technological development of the system. Certain developments are deliberately blocked while others are favoured. Although production and processing costs have to be kept down, the main focus of technological innovation is to maintain the quality difference with PR's main market competitors. Its objective is to prevent a rush versus the indiscriminate introduction of those technologies which may be able to reduce processing costs significantly, but may alter the product in such a way that PR cheese would loose its present market position. In a single industrial firm similar strategies are undertaken by its R&D department, in the PR system, however, this task is performed collectively by a group of actors and institutions involved in production who try to define the specific technological development path best suited to the product. The success of maintaining artisan production

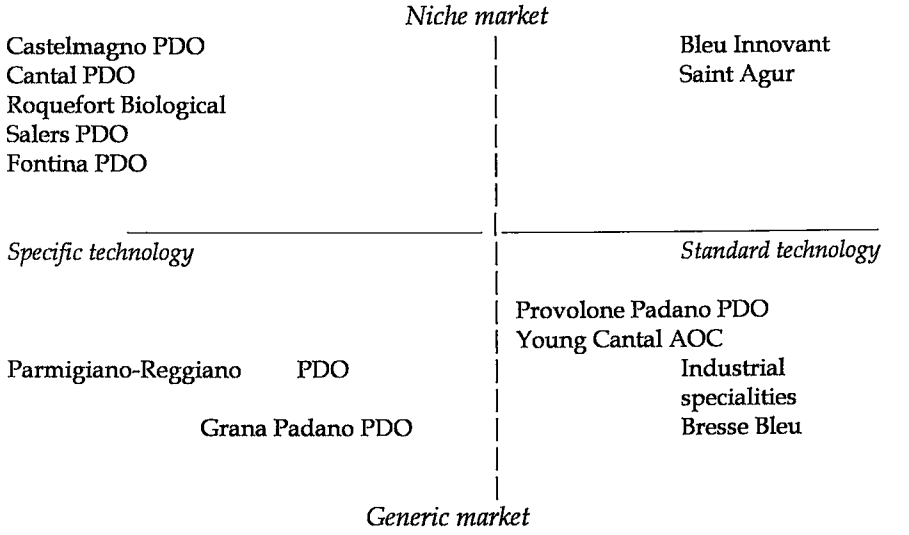
techniques has to be attributed to the capacity of the actors to arrive at a convergence of their individual objectives and strategies.
These four factors explain the uniqueness of the PR production system. A dairy system using artisan milk processing techniques, which represents 15 percent of the Italian milk market and is able to guarantee more than double employment in milk production and processing in less favoured areas. It also has a lower negative environmental impact than industrial dairy farms.

If these are the most important characteristics of the PR system as it is now, how is it likely to evolve in the future? Basic questions are:
1 Will the system maintain its distinctive characteristics?
2 Is the system able to resist external pressures?
3 Might there be internal disruptive forces?
4 Might there be a reason for the actors to abandon the current production techniques and turn towards industrialisation?

In order to deal with these questions we will begin by describing the market position of PR cheese using the axes proposed by Salais and Storper (1994). The horizontal axis indicates the degree of reproducibility of technology, opposing the specific to the standardised nature of technology. The vertical axis measures the market access of the product. On one side of this axis are the products serving a limited number of consumers and a specific market segment, on the other side are the products that serve a larger market segment. In the upper, left-hand corner are the regional-specific, high quality niche market products (Allaire and Sylvander 1995) and in the bottom, right-hand corner the generic mass consumption food products. The Parmigiano-Reggiano cheese can be located in the lower left-hand corner of the diagram, as it is produced with a highly specific technology and has a large market access.

This market position puts the PR system under continuous pressure to standardise its production and processing technology without loosing its link with the specific conditions of the production area. Moreover, the product faces competition from lower-priced alternatives, like the Grana Padano cheese that is produced in Lombardy at lower cost and using specific but more industrial-type techniques. If the consumer's price difference between these two products decreases, a significant shift towards the lower priced Grana Padano cheese may be noticed (Messori and Vezzani 1984). Maintaining and keeping control of production regulations should prevent standardising technology levelling-off the top qualities of the PR cheeses and reducing the quality distance between it and its closest competitors on the hard cheese market.

Figure 12.1 Market access and technological specificity of some French and Italian food products



Source: Salais and Storper (1994), Allaire and Sylvander (1995)

The fierce debate about technological innovations reflects the importance of the choices that have to be made. Among the different farm styles identified here, the large-scale, intensive farms with high-yielding cows seem to be more open to innovations capable of significantly reducing milk production costs. These vanguard farms, with a high proportion of hired labour and considerable bank exposure are more sensitive to reductions in production costs. These farm types are more integrated into the markets, but are more vulnerable to price fluctuations. They are more inclined to leave the Parmigiano-Reggiano system in times of price crises, for example. However, what is to the private benefit of some farmers is not always to the overall economic benefit of the system. Considering that the overall profit margin of a livestock system is the measure of its competitive force (Viaene 1986) the survival of the Parmigiano-Reggiano system is related to a long-term equilibrium between wholesale cheese prices and the sum of milk production and processing costs rather than absolute production unit costs.

In this period of globalisation, two tendencies may emerge: the abandonment of local culture exposed as it is to an increase in the supply of elements from a global culture, or the enforcement of local culture in defence of local identity. The long history of the cheese contributed to the enforcement of this culture up till now, but if in future short-term

profitability considerations will dominate the management decisions made by PR dairy farmers, this may weaken their commitment to the production system.

The further issue is the relationship between cheese dairies and maturing firms. Among cheese maturing firms there is an increasing market share that is being covered by firms who are less firmly attached to the PR cheese system. PR cheese is only one of the many cheeses these firms manage and often it is not their most important product. Moreover, these firms are located outside the PR production area and are less integrated into the local culture. Although product differentiation is a legitimate firm strategy, their limited involvement in the system may result in a reduction of product quality. Particularly important in this respect is an intensified quality control that aims to eliminate low-quality lots of cheese from market and to raise quality standards. The continuous effort of these firms to reduce the costs of maturing may not be compatible with the high quality of the cheese. In recent years they have tended to control the processing phase as well by buying up cheese dairies that have closed down. This bottom down, vertical integration may not be favourable for the PR system as whole.

This raises the question as to whether the cheese dairies should carry out the work of maturing the cheese themselves. A weak point in the PR system is that the cheese maturing firms are not fully integrated in the system. To a certain extent the system ends at the gate of the cheese dairy. The present study shows that up to now about 22 percent of cheese dairies mature cheese up to the end of the process. To enforce the market position of the cheese dairies with respect to the cheese maturing firms, proposals have been made to establish a collective selling agency (Lugli 1999) that would involve banks and some maturing firms. In this connection the involvement of local maturing firms specialised in PR cheese and which follow a focalisation strategy is important. The success of this proposal depends on the capacity to arrive at a sufficient convergence of objectives between the cheese dairies involved in the initiative. A balance has to be found between an increase in bureaucratic costs arising from maintaining the agency and a reduction in the transaction costs that the initiative might generate.

Finally, we may question whether this example of the PR cheese system could be repeated elsewhere, as a way of creating more employment in the countryside. Obviously we do not mean that attempts should be made to reproduce the cheese elsewhere. The high prices related to PR cheese have induced many producers and dairy industries to try to imitate the product. In Europe, all types of grated cheeses invoke the name Parmesan

to deliberately create associations with the well-known name of the original product to help increase sales. Outside Europe one example can be found in Argentina, where a cheese called Reggianito is produced as a substitute for PR by Italian immigrants and their descendants. The most striking imitation of PR cheese is marketed in Australia and is backed by an advertising campaign that uses the slogan 'The real Parmesan cheese, beware of imitations'.

All these products are produced on an industrial scale and their intrinsic and organoleptic qualities are different from the real PR cheese. On many occasions biochemical research has demonstrated the significant differences between PR cheese and its imitations, in particular the composition of the volatile fatty acids (Resmini *et.al.* 1988). The composition of the raw milk produced in the PR area and the artisan skills of the cheese-makers are the essential key ingredients that provide the characteristic taste, flavour and structure of the cheese.

Insights can be drawn from this emblematic case of a regional specific product that may be useful to rural development. Particularly interesting is the social organisation of the system and the way it has developed over time. A precondition for the success of any regional specific product is a strong link between the actors and the local culture and history of the area where the product originates. Although very strict product regulations can be designed for any regional specific product to help create a new segment for the product on the market, compliance with these rules and regulations can best be secured if the actors have a strong cultural attachment to the product. There is no quality certification body able to control the compliance of actors with product regulations if the actors themselves do not identify themselves with the product. New initiatives for the development of regional specific products on the market should be based on products supported by a minimum number of producers strongly convinced of its specificity and typicality. A strong cohesion of objectives between the initiators is essential for:

- The exploitation of the potential of value added to the product.
- The sharing of the value added among the actors whilst excluding any free-rider behaviour that may be apparent particularly at the beginning of product development.

If these factors are essential conditions on the supply side, on the demand side a significant number of consumers should have an interest in and be willing to pay for regional specific products. This manifest or hidden demand should be reached or discovered by the producers of a regional specific product either directly by direct sales, when product volumes are small or through multiple retail outlets when product volumes become larger. These ways of marketing involve quite different problems. Potentially successful products can fail to reach consumers when

marketed through large retail shops. Although the social organisation of production may be perfect, the last link to the market may ruin any fledgling and successful initiative (Roep 2000). The problem here is that the retailer is not 'linked' or 'involved' with the product. He does not share the same values as the producer groups. Large retailer groups may become more in line with the interest of the producer groups of PR cheese, when the selling of high quality PR cheese contributes to a differentiation strategy with respect to his competitors on the market [2]

The PR system is in many respects unique and cannot be reproduced elsewhere. Nevertheless, the interesting elements involved in the Parmigiano Reggiano process suggests how it may be possible to produce an agricultural product with significantly higher labour input and a lower environmental impact. Rural employment and eco-compatibility will be key elements in future European agriculture and the Parmigiano Reggiano system can be considered an emblematic case of how these two policy objectives can be combined.

Notes

[1] Here we may think of the plains of Parma and Reggio, the central mountains of Reggio and Modena and the eastern mountains in the province of Parma

[2] see examples of Chianina meat in Coop Toscana or in general Coop Italia in its battle against the French Carrefour, Auchan etc.

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Samenvatting

In veel opzichten is het produktiesysteem van de Parmezaanse kaas uniek. De verwerking van 1,35 miljoen ton melk in een hoogkwalitatief produkt in 600 kleine kaasmakerijen, waarbij voornamelijk ambachtelijke kleinschalige produktie technieken worden toegepast is nergens anders in Europa te vinden. De hoge arbeidsinzet zowel op de melkveehouderijen als in de kaasmakerijen schept aanzienlijk meer werkgelegenheid dan andere zuivelsystemen. Ongeveer 20.000 mannen en vrouwen werken elke dag in dit speciale produktiesysteem, terwijl in een industrieel zuivelsysteem die dezelfde hoeveelheid melk verwerkt een vergelijkbaar inkomen valt te verdienen voor niet meer dan 8.000 mensen. De kwaliteit van de kaas is sterk afhankelijk van het vakmanschap van de kaasmaker, die dagelijks rauwe melk verwerkt, waarvan de samenstelling van dag tot dag en van bedrijf tot bedrijf sterk varieert en waaraan hij niets anders toevoegt dan verzuurde wei van de de dag ervoor en stremsel.
In een industrieel systeem is melk de grondstof voor een breed aanbod van verschillende zuivelprodukten die het resultaat zijn van een combinatie van technologieen en toevoegingsmiddelen die voortkomen uit het biochemische onderzoek. De vraag die in dit proefschrift centraal staat is: hoe is mogelijk dat de productie van Parmezaanse kaas voortgezet wordt met ambachtelijke en arbeidsintensieve technieken terwijl alle andere zuivelsystemen in Europa in de loop der tijd industriële technieken hebben ingevoerd? Waarom is dit systeem niet geïndustrialiseerd zoals de meeste andere voormalig ambachtelijke systemen in andere landen?
Het antwoord op deze vragen moet gezocht worden in theorieën die verder reiken dan het liberaal atomistische concept van de winstmaximaliserende '*homo economicus*'. Het menselijk gedrag kan niet begrepen worden zonder het te plaatsen in zijn institutionele en sociale context. Het probleem is dat noties als loyaliteit, vertrouwen en saamhorigheid niet gemakkelijk passen in de gangbare economische theorie.
De theorie aangaande economische districten en instituties bevat een sterk interpretatief kader voor het begrijpen van de economische validiteit en

persistentie van het productiesysteem van de Parmezaanse kaas. De integratie van positieve externaliteiten in de bedrijfsbalans verlaagt de hogere kosten die inherent zijn aan de kleinschalige productie. In de meer perifere zones van het Parmezaanse productiegebied, waar het netwerk van kaasmakerijen schaarser is, is de tendens om het systeem te verlaten tijdens een prijscrisis groter dan in de zones met een hoge concentratie kaasmakerijen. In die gebieden is de geografische dichtheid van kaasmakerijen onvoldoende om een systeem van gezamenlijk gedeelde waarden en normen en saamhorigheid te creëren ten aanzien van het productiesysteem. In de meer centrale deelgebieden is dit gevoel veel sterker.

De kleinschalige coöperatieve structuur van de kaasmakerijen is een tweede factor van belang voor de verklaring van de kracht van het systeem. De sterke integratie van melk en kaasproductie verlaagt de transactiekosten aanzienlijk. Wederzijdse trouw en loyaliteit van de leden aan de kaasmakerij versterken zijn sociale organisatie. Schaalvergroting van en fusies tussen kaasmakerijen zijn altijd onderwerp van felle debatten. Deze omvatten niet alleen de confrontatie van twee politieke werelden, maar er bestaat vaak de angst dat de schaalvergroting de kwaliteit van de kaas niet ten goede zal komen. De kaasmaker moet de controle over een aantal sleuteloperaties blijven behouden, aangezien dit een garantie is voor de kwaliteit van de kaas. Juist deze voorwaarde remt een snelle schaalvergroting af. Veel kaasmakerijen hebben constante marktrelaties met slechts één of twee kaasopslagbedrijven. Hoewel het wellicht economisch aantrekkelijker is de kaas te verkopen aan de hoogste bieder, is de vaste marktrelatie met dezelfde opkoper een garantie voor een hogere betrouwbaarheid, hetgeen op zijn beurt de transactiekosten verder verlaagt.

Een derde pijler waarop het productiesysteem van de Parmezaanse kaas rust is het gezinsbedrijf. Dit bedrijfstype kent lagere monetaire kosten dan bedrijven die primair aangewezen op betaalde arbeidskrachten. Bovendien volgen veel melkveehouderijen een bedrijfsstijl die voorziet in een lage integratie in de markt van productiemiddelen, wat de monetaire kosten verder reduceert. Het lage aandeel van de monetaire kosten in de totale productiekosten maakt het vele bedrijven mogelijk periodes met lage prijzen te doorstaan en ook al is in dergelijke periodes de verleiding groot over te gaan op de productie van industriële melk, deze bedrijven zetten de specifiek melkproductie voor Parmezaanse kaas voort. De verslechtering van de prijsverhouding tussen inputs and outputs dringt op deze bedrijven minder verder door dan op bedrijven die meer marktafhankelijk zijn. Melkveehouders die deel uitmaken van het systeem zijn zich bewust van de soms sterke prijsschommelingen en houden daar in hun bedrijfsbeslissingen rekening mee.

Gerekend over een periode van acht jaar is de gedefleerde gemiddelde opbrengstprijs van melk voor Parmezaanse kaas vergelijkbaar met de gedefleerde prijs van melk voor industriële melk, alleen de melkprijs voor Parmezaanse kaas beloont een veel hogere arbeidsinzet dan de prijs voor industriële melk. In hun bedrijfsbeslissingen rekenen de melkveehouders met een economische efficiency op lange termijn, waarbij periodes van hoge prijzen worden uitgebalanceerd met periodes van lage prijzen.
De vierde factor die bijdraagt tot het unieke karakter van het systeem is de institutionele betrokkenheid. Plaatselijke onderzoekscentra en locale overheden geven richting aan de technologische ontwikkeling van het systeem. Bepaalde ontwikkeling worden bewust afgeremd en andere worden gestimuleerd. Alhoewel de productie- en verwerkingskosten van melk laag gehouden moeten worden, is de belangrijkste drijfveer voor technologische innovatie de handhaving van het kwaliteitsverschil van Parmezaanse kaas met concurrerende kazen op de markt. Het doel van technologische innovatie is te voorkomen dat een serie technieken ingevoerd worden die weliswaar de productiekosten drastisch kunnen drukken, maar de productkwaliteit naarmate aantasten dat de kaas zijn markt positie zou kunnen verliezen. Binnen een enkel industrieel bedrijf worden dergelijke strategieën uitgestippeld door de R&D afdeling. In het systeem van de Parmezaanse kaas wordt deze taak collectief uitgevoerd door melkveehouders en instituties die betrokken zijn bij de productie e die pogen het meeste geschikte technologisch ontwikkelingstraject uit te zetten. Het succes van het handhaven van de ambachtelijke productietechnieken moet toegeschreven worden aan capaciteit van de betrokkenen om te komen tot een convergentie van de individuele bedrijfsdoeleinden en strategieën.
Deze vier factoren verklaren het unieke karakter van het productiesysteem van de Parmezaanse kaas, een zuivelsysteem gebaseerd op ambachtelijke arbeidsintensieve productietechnieken, wat 15 procent van de Italiaanse melkproductie vertegenwoordigt en in staat is twee keer zoveel werkgelegenheid te creëren dan een industrieel zuivelsysteem. Het systeem stimuleert bovendien de economische ontwikkeling in berggebieden en kent een betere milieubalans dan een industrieel systeem.
Dit zijn de meest belangrijke karakteristieken van het systeem zoals het nu werkt. De vraag is hoe het systeem in de toekomst zich zal ontwikkelen.. Zal het zijn specifieke karakter behouden en zal het druk van buitenaf kunnen weerstaan? Zijn er redenen voor de betrokkenen om de huidige productietechnieken te verlaten en de weg van verdergaande industrialisatie in te slaan?
Het is een feit dat de marktpositie van de Parmezaanse kaas het systeem voordurend onder druk zet om zijn productie- en verwerkingstechnologie te standaardiseren en een dergelijke tendens kan de band met de

specifieke locale omstandigheden in gevaar brengen. Het product ondergaat concurrentie van lager geprijsde concurrenten zoals de Grana Padano kaas die met lagere kosten maar met meer industriële technieken in het nabijgelegen Lombardije wordt geproduceerd.
Het hevige debat dat rondom de technologische innovatie wordt gevoerd is een graadmeter van de spanning onder de betrokkenen en geeft het belang aan van de keuzes die moeten worden gemaakt. Onder de verschillende bedrijfsstijlen die in het systeem zijn onderkend zijn vooral de grote intensieve bedrijven het meest open ten aanzien van de introductie van innovaties die de productiekosten aanzienlijk kunnen verlagen. Deze koploperbedrijven met een hoog aandeel betaalde arbeid en vreemd kapitaal zijn meer gevoelig voor prijsschommelingen, meer geïntegreerd in input markten en dus meer voorstanders van een aanzienlijk verlaging van de kostprijs. Dit type bedrijf is het meest geneigd het systeem te verlaten tijdens prijscrises.
In de huidige periode van de snel groeiende globalisering komen twee tendensen naar voren: het verlaten van de locale cultuur onder druk van het blootstaan aan elementen van de globale cultuur of een versterking van de locale cultuur ter verdediging van de locale identiteit. De lange geschiedenis van de Parmezaanse kaas heeft bijgedragen aan de versterking van de locale cultuur, maar als in de toekomst korte termijn winstberekeningen de bedrijfsbeslissingen gaan domineren dan kan dat de gehechtheid aan het systeem aantasten.
Uiteindelijk kunnen we ons afvragen of het voorbeeld van het productiesysteem van de Parmezaanse kaas in andere delen van de wereld navolging kan vinden om op deze wijze meer werkgelegenheid op het platteland te creëren. Kunnen uit dit voorbeeld nuttige lessen getrokken worden voor rurale ontwikkeling?
Bijzonder interessant is de sociale organisatie van het systeem en de manier waarop het zich ontwikkeld heeft. Een voorwaarde voor succes van een streekeigen product is de sterke band van de betrokkenen onderling, met de locale cultuur en met de geschiedenis van het gebied waarin het product wordt geproduceerd. Ook al kunnen strenge productieregels opgesteld worden voor elk streekeigen product om op die manier een sterk marktsegment op te bouwen, het naleven van de productieregels kan alleen gegarandeerd zijn wanneer de betrokkenen zelf sterk gehecht zijn aan de locale cultuur. Een certificeringsorgaan kan het naleven van de regels nooit afdoende controleren als de betrokkenen zich niet met het product identificeren. Nieuwe initiatieven gericht op de ontwikkeling van een streekeigen product moeten gedragen worden door een minimum aantal producenten die sterk overtuigd zijn van het specifieke karakter en de typiciteit van het product.
Als deze factoren essentieel zijn voor de aanbodzijde, aan de vraagzijde zal er een significant aantal consumenten moeten zijn die belangstelling

tonen in het product en bereid zijn ervoor een hoge prijs te betalen. Deze verborgen of open vraag zal bediend moeten worden door de producenten van het streekeigen product door directe verkopen wanneer de product volumes klein zijn e door de grote distributie wanneer de volumes groter worden. Grote supermarkten kunnen op een lijn gebracht worden met de belangen van de producenten van streekeigen producten, als de verkoop van deze producten bijdraagt aan een differentiatiestrategie van het bedrijf ten opzichte van zijn concurrenten.
Het productiesysteem van de Parmezaanse kaas is in vele opzichten uniek en kan niet ergens anders gereproduceerd worden. Ondanks dat bevat het interessante elementen die kunnen aangeven hoe een landbouwproduct met een hogere arbeidsinzet en een lagere milieudruk rendabel geproduceerd kan worden. Rurale ontwikkeling en duurzaamheid zijn sleutelelementen voor de Europese landbouw en het productiesysteem van de Parmezaanse kaas kan beschouwd worden als een uitgesproken voorbeeld van hoe deze beleidsdoelstellingen gecombineerd kunnen worden.

Summary

In many respects the Parmigiano-Reggiano production system is a unique dairy system. The processing of 1.35 million tons of milk into a high quality product in 600 small cheese dairies using predominantly artisan production techniques is not found anywhere else in Europe. The high labour input required both on the dairy farms and in the cheese dairies creates considerably more employment than any other dairy system. About 20,000 men and women work everyday in this very special system. In an industrial dairy system designed to produce the same quantity of milk, no more than 8,000 people would be employed. The final quality of the cheese is heavily dependant on the ability of the cheese-maker to process the different qualities of raw milk – which varies from season to season and from farm to farm – without using any additive except for the dairy-based whey starter and rennet.

In an industrial dairy system milk is the raw material for a wide range of dairy products all of which are the result of a combination of technological processes and additives and the latest bio-chemical research. The central question addressed in this study was formulated as follows. Given the fact that most European dairy systems have adopted industrial production techniques, how has the Parmigiano Reggiano systems been able to maintain the use of artisan, labour intensive techniques? Why has this system not industrialised, like other ancient cheese production systems in many other countries?

The answer to these questions can only be found if we use theories that go beyond the liberal, atomistic conception of the profit maximising '*homo economicus*'. His behaviour can only be understood when his institutional and social context is taken into account. The problem is that notions such as loyalty, commitment, trust and a sense of belonging do not fit easily into economic concepts. Although it must be said that more recent economic theories are moving towards an incorporation of concepts that go beyond mere economic variables to take account of the behaviour of the actors involved.

The theory on economic districts and institutions contains considerable interpretative power and can help us understand the reasons for the

economic validity and persistence of the Parmigiano-Reggiano system. The integration of positive externalities generated within the district into the firm balance, alleviates the higher costs generated by limited economies of scale in predominantly small firms. In the peripheral zones of the Parmigiano Reggiano production area, where the network of cheese dairies is less dense the tendency to resist during periods of price crises is weaker than in areas with a high concentration of cheese dairies. Here, a dairy farm will be more likely to close down for there is neither the density of farms or sufficient cheese dairies to create a system of common shared values about how milk should be produced. Neither is there a sense of belonging to the Parmigiano Reggiano system. These common values and a sense of belonging are very strong in the central zones of the Parmigiano Reggiano production area.

The small-scale co-operative structure of the cheese dairies is a second factor that is also extremely important to the strength of the system. The strong integration of milk production and milk processing significantly reduces the transaction costs in this link of the Parmigiano -Reggiano system. Mutual trust and loyalty to the cheese dairy on the part of its members are the basic forces that hold this social organisation together. Enlarging the scale of the cheese dairies and effecting mergers with other dairies are subjects that always generate fierce debate. They not only involve the clash of two political worlds, but there is also the fear that such changes might have a detrimental effect on the final quality of the cheese. The fact that the cheese-maker must exercise control over key operations within the production process is regarded as a prerequisite for the quality of the cheese and puts a brake on any development towards large-scale processing units.

Many cheese dairies have market relations with just one or two cheese maturing firms and these commitments do not change much over time. Although many improvements may take place in this market relationship to the benefit of the cheese dairies, the stability of sales to a few purchasers guarantees a high reliability and this in turn reduces transaction costs.

A third important pillar of the Parmigiano -Reggiano system is the family farm structure that characterises the majority of Parmigiano -Reggiano dairy farms. These types of farm have lower monetary costs than farms that rely primarily on hired labour. Moreover, many dairy farms follow a style of farming that foresees a low integration into input markets, a factor that contributes significantly to reducing monetary costs. The low proportion of monetary costs within total production costs enables many farms to survive periods of price crises. Even though the temptation to produce industrial milk is high during difficult times, farmers will continue to produce milk for Parmigiano -Reggiano cheese. This is because deterioration's in the input/output price ratio does not penetrate

their farm management decisions to the same extent it penetrates the decisions of farms that are more dependent on market price fluctuations. Dairy farmers who belong to the Parmigiano -Reggiano system are conscious of these strong price variations. During periods of high prices, which may exceed industrial milk prices by 30-40 percent, investments are made in new cowsheds, machinery and equipment.

On average the deflated average price for Parmigiano -Reggiano milk over an eight-year period is similar to the deflated average industrial milk price, but the Parmigiano -Reggiano price remunerates a much higher labour input than the industrial milk price. In their management decisions Parmigiano -Reggiano dairy farmers take into account the long-term economic efficiency of their farms and are prepared to balance out periods of high prices with periods of low prices.

The fourth factor that contributes to the uniqueness of the Parmigiano - Reggiano system is institutional involvement. Local research centres, representative bodies and the public administration direct the specific technological development of the system. Certain developments are deliberately blocked while others are favoured. Although production and processing costs have to be kept down, the main focus of technological innovation is to maintain the quality difference with Parmigiano - Reggiano main market competitors. Its objective is to prevent a rush versus the indiscriminate introduction of those technologies which may be able to reduce processing costs significantly, but may alter the product in such a way that Parmigiano -Reggiano cheese would loose its present market position. In a single industrial firm similar strategies are undertaken by the R&D department. In the Parmigiano -Reggiano system, however, this task is performed collectively by a group of actors and institutions who are involved in production and who try to define the specific technological development path best suited to the product. The success of maintaining artisan production techniques has to be attributed to the capacity of the actors to arrive at a convergence of their individual objectives and strategies.

These four factors explain the uniqueness of the Parmigiano-Reggiano production system. It is a dairy system that uses artisan milk processing techniques, represents 15 percent of the Italian milk market, and is able to guarantee more than double employment in milk production and processing. Further, it is able to sustain economic development in less favoured areas and has a significantly better environmental impact than industrial dairy farms.

If these are the most important characteristics of the Parmigiano - Reggiano system as it is now, the question is how is it likely to evolve in the future. Will the system maintain its distinctive characteristics and is it able to resist external pressures? Might there be some reason for the actors

to abandon the current production techniques and turn towards industrialisation?

The fact is that its market position puts the Parmigiano -Reggiano system under constant pressure to standardise its production and processing technology and this may compromise its link with the specific conditions of the production area. Moreover, the product faces competition from lower-priced alternatives, such as the Grana Padano cheese produced in Lombardy at lower cost and using specific but more industrial-type techniques.

The fierce debate about technological innovations reflects the importance of the choices that have to be made. Among the different farm styles identified, the large-scale, intensive farms with high-yielding cows seem to be more open to innovations that can lead to reductions in milk production costs. These vanguard farms, with a high proportion of hired labour and considerable bank exposure are more sensitive to reductions in production costs. They are more integrated into the markets but, at the same time, they are also more vulnerable to price fluctuations. This type of farm is more inclined to leave the Parmigiano-Reggiano system in times of price crises.

In this period of rapid increasing globalisation two tendencies may emerge: the abandonment of local culture under pressure of the increasing amount of exposure to elements from a global culture, or the enforcement of local culture in defence of local identity. The long history of Parmigiano -Reggiano cheese has contributed to the enforcement of this culture up to now, but if in future short-term profit considerations come to dominate the management decisions made by Parmigiano -Reggiano dairy farmers, this may weaken their commitment to the production system.

Finally, we may question whether this example of the Parmigiano - Reggiano cheese system could be repeated elsewhere as a way of creating more employment in the countryside. Insights can be drawn from this emblematic case of a regional specific product that may be useful to rural development. Particularly interesting is the social organisation of the system and the way it has developed over time. A precondition for the success of any regional specific product is a strong link between the actors and the local culture and history of the area where the product originates. Although very strict product regulations can be designed for any regional specific product to help create a new segment for the product on the market, compliance with these rules and regulations can best be secured if the actors have a strong cultural attachment to the product. There is no quality certification body able to control the compliance of actors with product regulations if the actors themselves do not identify with the product. New initiatives for the development of regional specific products on the market should be based on products supported by a minimum number of producers strongly convinced of its specificity and typicality.

If these factors are essential conditions on the supply side, on the demand side a significant number of consumers should have an interest in and be willing to pay for regional specific products. This manifest or hidden demand should be reached or discovered by the producers of a regional specific product either directly by direct sales, when product volumes are small or through multiple retail outlets when product volumes become larger. Large retailer groups may come more into line with the interest of producer groups involved in the procesing of regional specific products, if the selling of these products contributes to their differentiation strategy as far as their competitors on the market are concerned.

The Parmigiano-Reggiano system is in many respects unique and cannot be reproduced elsewhere. Nevertheless, the interesting elements involved in the Parmigiano Reggiano process suggests how it may be possible to produce an agricultural product with significantly higher labour input and a lower environmental impact. Rural employment and eco-compatibility will be key elements in future European agriculture and the Parmigiano Reggiano system can be considered an emblematic case of how these two policy objectives can be combined.

Sintesi

Per molti aspetti il sistema di produzione del Parmigiano-Reggiano è un sistema caseario unico. La trasformazione di 1,35 milioni di tonnellate di latte in un prodotto di alta qualità, effettuata in 600 piccoli caseifici con tecniche produttive soprattutto artigianali, è un fenomeno difficilmente riscontrabile altrove in Europa. L'elevato impiego di lavoro necessario sia nelle aziende agricole che in quelle casearie, crea molta più occupazione che in qualsiasi altro sistema caseario. Sono circa 20.000 gli uomini e le donne che lavorano ogni giorno in questo sistema di produzione. In un sistema industriale con la stessa produzione di latte, non troverebbero un impiego remunerativo più di 8.000 persone. La qualità finale del formaggio dipende in grande misura dalla capacità del casaro di lavorare le diverse qualità di latte, che mutano da stagione a stagione e da azienda a azienda, senza utilizzare alcun additivo tranne il siero di latte ed il caglio.

Nell'industria casearia, il latte è la materia prima per una vasta gamma di prodotti che sono tutti il risultato di una combinazione di processi tecnologici, additivi e della più aggiornata ricerca biochimica. La questione centrale di questo studio era: dato che la maggioranza dei sistemi lattiero-caseari sparsi in tutta Europa hanno adottato tecniche di produzione industriale, come ha potuto il sistema del Parmigiano Reggiano conservare tecniche artigianali ad alta intensità di lavoro? Perché questo sistema non si è industrializzato come tutti i vecchi sistemi di produzione del formaggio di molti altri paesi?

La risposta a queste domande va ricercata utilizzando delle teorie che vanno oltre il concetto atomistico liberale dello 'homo economicus' che tende alla massimizzazione del profitto. Il comportamento del sistema del Parmigiano Reggiano si può comprendere solo se si prendono in considerazione i contesti istituzionali e sociali dell'area di produzione. Il problema è che concetti come lealtà, senso di responsabilità, fiducia e appartenenza mal si adattano ai concetti puramente economici. Nuove teorie economiche cercano ora ad incorporare tali concetti che vanno oltre le mere variabili economiche del comportamento delle persone e delle imprese.

La teoria dei distretti e delle istituzioni economiche offre una grande capacità interpretativa quando si tratta di comprendere le ragioni della validità e della continuità del sistema del Parmigiano Reggiano. L'integrazione delle esternalità, generate all'interno del distretto, nel bilancio dell'azienda compensa i maggiori costi dovuti alle ridotte economie di scala in aziende prevalentemente piccole. Nelle zone periferiche dell'area di produzione del Parmigiano Reggiano, dove la rete di caseifici è meno fitta, la capacità di resistenza nei periodi di crisi di prezzo è, infatti, inferiore a quella delle aree a maggiore densità di caseifici. In quelle zone sarà più alta la probabilità che un'azienda agricola chiuda. Non c'è in queste zone la densità di aziende o di caseifici sufficiente a creare un sistema di valori condivisi in merito a come va prodotto il latte, né un senso comune di appartenenza al sistema del Parmigiano Reggiano. Questi valori comuni ed il senso di appartenenza sono invece molto forti nelle zone centrali dell'area di produzione del Parmigiano Reggiano.

L'organizzazione dei caseifici in piccole cooperative è il secondo fattore di grande rilevanza per la forza del sistema. La forte integrazione tra produzione e lavorazione del latte riduce i costi di transazione in questo settore del sistema del Parmigiano Reggiano. La fiducia reciproca e la fedeltà al caseificio da parte dei membri della cooperativa sono le forze basilari che tengono insieme questa organizzazione sociale. L'allargamento della scala di questi caseifici e le fusioni con altri caseifici sono argomenti che fanno sempre sorgere animati dibattiti. Non solo comportano lo scontro di due mondi politici, ma esiste anche il timore che tali cambiamenti possano avere un effetto negativo sulla qualità finale del formaggio. Il fatto che il casaro deve avere il pieno controllo delle operazioni chiave del processo di produzione viene visto come un requisito essenziale per la qualità del formaggio e frena quindi qualsiasi sviluppo verso grandi unità di lavorazione.

Molti caseifici intrattengono relazioni commerciali solo con una o due aziende di stagionatura ed difficilmente cambiano acquirente. Anche se sarebbero possibili molti miglioramenti in questi rapporti commerciali a beneficio dei caseifici, la continuità della vendita a pochi compratori crea un elevato senso di fiducia reciproca che a sua volta riduce i costi di transazione.

Il terzo importante pilastro del sistema del PR è la struttura di azienda familiare che caratterizza la maggioranza delle aziende agricole del PR. Questo tipo di azienda agricola ha costi monetari inferiori a quelli delle aziende che ricorrono principalmente a mano d'opera retribuita. Inoltre, molte aziende agricole utilizzano uno stile di allevamento che prevede un basso uso di mezzi tecnici reperibili sul mercato; un fattore, questo, che contribuisce a ridurre ancora di più i costi monetari. La ridotta proporzione di costi monetari rispetto ai complessivi costi di produzione

permette a molte aziende di superare i periodi di crisi di prezzo. Anche se la tentazione di produrre latte industriale è forte in quei periodi, continueranno a produrre il latte per il formaggio PR. Ciò perché il calo del rapporto costi/ricavi non incide sulle decisioni gestionali di questo tipo di azienda nella misura in cui incide sulle decisioni di aziende agricole più soggette alle fluttuazioni dei prezzi di mercato. Gli agricoltori che appartengono al sistema del PR sono ben consapevoli di queste forti variazioni di prezzo. Durante i periodi di prezzo elevato, che possono superare anche del 30-40 percentuale i prezzi del latte industriale, vengono fatti investimenti in nuove stalle, nuovi macchinari e nuove attrezzature.

In media il prezzo medio deflazionato del latte per il PR nell'arco di un periodo di otto anni è simile al prezzo medio deflazionato del latte industriale, ma il ricavo nel settore del PR serve a remunerare un maggior numero di addetti rispetto al settore del latte industriale. Nelle loro decisioni gestionali gli agricoltori del settore del PR tengono in considerazione il risultato economico a lungo termine delle loro aziende e sono quindi preparati a compensare le differenze di reddito tra i periodi di prezzi elevati e quelli di prezzi bassi.

Il quarto fattore che contribuisce all'unicità del sistema del PR è il coinvolgimento istituzionale. Centri di ricerca locali, organi rappresentativi e pubblica amministrazione sono direttamente interessati allo specifico sviluppo tecnologico del sistema. Certi sviluppi vengono deliberatamente bloccati mentre altri vengono favoriti. Anche se i costi di produzione e di trasformazione devono essere tenuti sotto controllo, l'obiettivo principale dell'innovazione tecnologica è quello di mantenere inalterata la differenza di qualità con i principali concorrenti che il PR ha sul mercato. Lo scopo di tali istituzioni è di impedire la corsa verso l'introduzione indiscriminata di quelle tecnologie che potrebbero ridurre sensibilmente i costi di lavorazione, ma contribuirebbero ad alterare il prodotto in modo tale da far perdere al formaggio PR la propria attuale posizione di mercato. In un'industria, simili strategie sono di competenza del reparto di R&S, ma nel sistema del PR questo compito è svolto collettivamente da un gruppo di attori e di istituzioni che si occupano della produzione e che cercano di definire lo specifico percorso di sviluppo tecnologico più adatto al prodotto. L'essere riusciti a mantenere tecniche di produzione artigianale, va attribuito alla capacità degli attori di raggiungere una convergenza tra i loro rispettivi obiettivi e le loro rispettive strategie.

Questi quattro fattori spiegano l'unicità del sistema di produzione del PR, un sistema caseario che utilizza tecniche artigianali di trasformazione del latte, che rappresenta il 15 percentuale del mercato italiano del latte e che è in grado di assicurare un'occupazione più che doppia nei settori della produzione e della lavorazione del latte, capace di supportare uno

sviluppo economico di aree svantaggiate e che ha un migliore impatto ambientale rispetto alle aziende agricole che producono latte industriale.
Se queste sono le più importanti caratteristiche dell'attuale sistema del PR, la domanda da porsi è quale possa essere la sua probabile evoluzione futura. Manterrà le sue caratteristiche distintive e sarà capace di resistere alle pressioni esterne? Potrà esserci un motivo che farà abbandonare le attuali tecniche di produzione in favore dell'industrializzazione?
Il fatto è che la sua posizione di mercato mette il sistema del PR sotto una continua pressione rivolta alla standardizzazione della propria produzione e della tecnologia di trasformazione che comprometterebbe la connessione con le condizioni specifiche dell'area di produzione. Inoltre, il prodotto deve affrontare la concorrenza di prodotti alternativi a prezzo inferiore, come il Grana Padano che viene prodotto in Lombardia a costo inferiore e utilizzando tecniche specifiche ma di tipo più industriale.
Il sostenuto dibattito sulle innovazioni tecnologiche riflette l'importanza delle scelte da fare. Tra i diversi tipi di azienda agricola identificati, le aziende intensive di grandi dimensioni con vacche ad elevata produzione sembrano essere più disponibili all'introduzione di innovazioni in grado di ridurre sensibilmente i costi di produzione del latte. Queste aziende all'avanguardia, con molta mano d'opera stipendiata e forte esposizione bancaria sono più sensibili alle riduzioni dei costi di produzione. Questo tipo di azienda è maggiormente integrata nel mercato, ma è più vulnerabile rispetto alle fluttuazioni dei prezzi. In tempi di crisi di prezzo esse saranno le più tentate a lasciare il sistema del Parmigiano Reggiano.
In questo periodo di sempre maggiore globalizzazione possono emergere due tendenze: l'abbandono della cultura locale, esposta com'è all'influenza crescente di elementi culturali globali, oppure il rafforzamento della cultura locale a difesa dell'identità locale. La lunga storia del formaggio ha contribuito, fino ad ora, al rafforzamento di questa cultura, ma se nel prossimo futuro considerazioni di profitto a breve termine dovessero avere la meglio nelle decisioni gestionali delle aziende agricole del settore del PR, ciò potrebbe indebolirne l'attaccamento al sistema di produzione.
Per finire, potremmo chiederci se questo esempio del sistema del formaggio PR potrebbe riprodursi altrove, come modo di creare maggior occupazione nelle aree rurale. Si potrebbero trarre dei suggerimenti da questo emblematico caso di uno specifico prodotto regionale che potrebbero essere utili allo sviluppo rurale. Particolarmente interessante è l'organizzazione sociale del sistema ed il modo in cui si è sviluppata nel tempo. Condizione essenziale al successo di un qualsiasi specifico prodotto regionale è il forte collegamento tra gli attori e la cultura locale e la storia dell'area dal quale il prodotto origina. Nonostante si possano istituire dei regolamenti molto severi per ogni prodotto tipico regionale

per aiutare la creazione di un nuovo segmento di mercato per il prodotto stesso, il rispetto di tali regole può essere garantito solo dal forte attaccamento culturale degli attori al prodotto. Non esiste organismo di certificazione della qualità che possa controllare il rispetto da parte degli attori delle regole di produzione se gli attori stessi non si identificano con il prodotto. Ogni nuova iniziativa per lo sviluppo di prodotti tipici regionali dovrebbe basarsi su una tipologia di prodotto che possa vantare un minimo numero di produttori tenacemente convinti della sua specificità e tipicità.

Se questi fattori sono essenziali per quanto riguarda la produzione, da parte della domanda dovrebbe esistere un certo numero di consumatori interessati e disposti a pagare per dei prodotti tipici regionali. Questa domanda, manifesta o nascosta, andrebbe raggiunta o scoperta da parte dei produttori di un prodotto tipico regionale con vendite dirette, quando i volumi di produzione sono ridotti o tramite la grande distribuzione organizzata quando i volumi diventano maggiori. I grandi gruppi di distribuzione al dettaglio possono essere in linea con gli interessi dei gruppi di produzione di un prodotto tipico regionale quando l'offerta in vendita di questi prodotti contribuisca ad una loro differenziazione sul mercato rispetto ai loro diretti concorrenti.

Il sistema del PR è, per molti aspetti, unico e non può essere riprodotto altrove. Ciò nonostante gli elementi di interesse riscontrabili nel settore del Parmigiano Reggiano suggeriscono come possa essere possibile una produzione agricola ad elevata occupazione ed a basso impatto ambientale. Lo sviluppo rurale e la eco compatibilità saranno elementi chiave della futura agricoltura Europea ed il sistema del Parmigiano Reggiano può essere considerato un caso emblematico di come questi due obbiettivi politici possano combinarsi.

Curriculum Vitae

Kees de Roest was born in Ommelanderwijk in the province of Groningen the 13th of Agust 1954. High school he followed in Drachten (NL) and in 1973 he graduated in Gymnasium B. At the Agricultural University of Wageningen he studied Agricultural Economics, with Sociology and Developments Economics as by studies. During his studies he acquired in 1977 practical research experience at the Institute of Farm Income Research at Tel-Aviv, Israel, studying the economic results of family farms in cooperatives (moshavim) and private settlements. He obtained his Masters Degree in September 1980 and after his studies he started work at the Institute of Animal Production at the University of Udine in the North of Italy, where he completed a study on the milk production costs in Lombardy and the Netherlands. From 1982 until the summer of 1983 he completed his civil service at the Department for Agriculture of the Province of Gelderland (NL). From 1983 onwards he is employed at the Research Centre for Animal Production in Reggio Emilia, where he is involved in socio-economic studies concerning the different animal production systems in Italy. He participated in several EU funded research projects related to the supply chains of regional specific products, to the economic and environmental impact of intensive animal production and to the future of rural development in Europe.