Preface

The World Trade Organization (WTO) will initiate negotiations on the further liberalization of the global trade with agricultural commodities by the end of 1999. These negotiations are based on Article 20 of WTO's Agreement on Agriculture (Uruguay Round), which states, *inter alia*, that the reform process is to be continued, with the long-term objective of substantial and progressive reductions in the support and protection of the agricultural sector.

The Norwegian authorities have started preparations for the new round of WTO negotiations. In this connection, the Norwegian Agricultural Economics Research Institute (NILF) was asked by the Royal Ministry of Agriculture to carry out a study in order to elucidate the conditions for farming in Norway as compared to those countries with a strongly export-oriented agriculture. The study was to include the different countries' natural conditions, and, as far as possible, examine the consequences of varying natural conditions on agricultural production. This includes the total area of farmland and the distribution of farmland, farming types and production costs within the countries.

Runhild Gudem was the project leader and has also written chapters 1, 2 and 3 and subchapter 4.1 of this report, whereas subchapter 4.2-4.3 were written by Ivar Hovland. The agroclimatic data presented in the report was prepared by Endre Skaar of the Norwegian Crop Research Institute (Planteforsk).

Nils Kristian Nersten and Viil Søyland read the manuscript and made comments on it. The report was translated from Norwegian by Karl Kerner.

Oslo, November 1999

Leif Forsell
Director

Contents

Tables

*Note: **..** means ”missing data”*

Figures

1 Introduction

1.1 Background

The World Trade Organization (WTO) will initiate negotiations on the further liberalization of the global trade with agricultural commodities by the end of 1999. These negotiations are based on Article 20 of WTO's Agreement on Agriculture (Uruguay Round), which states, *inter alia*, that the reform process is to be continued, with the long-term objective of substantial and progressive reductions in the support and protection of the agricultural sector.

The Norwegian authorities have started preparations for the new round of WTO negotiations, and in this connection wish to compare the conditions for farming in Norway with those in the major exporting countries France, USA, New Zealand and Australia. The study is to include a survey of farm structure, labour costs, climate and other relevant natural conditions. The aim is to gain some insight into the importance of natural conditions for agricultural production costs.

However, it is not easy to directly associate or limit costs to natural conditions alone. Costs are usually a function of several factors, including political, legal, economical, historic, cultural and natural ones. The project aims at surveying and quantifying some of the factors influencing production costs in the mentioned countries. The project is by no means a complete survey of production conditions, since this could not be achieved within the scope of the study. We have chosen to limit data collection to meat production (beef and sheepmeat), dairy and cereal farming, since these productions to a large degree are influenced and limited by the prevailing natural conditions.

The results are presented as comparisons of data from each of the countries, in addition to information from the Food and Agriculture Organization of the United Nations (FAO) and the Organization for Economic Co-operation and Development (OECD). The accessibility and comparability of data are uncertain factors throughout the project. The different countries' statistics and databases are often not directly comparable, since they apply different statistical selection methods, limitations and definitions. One must therefore be somewhat careful when comparing certain data. Nevertheless, the presented information can give an indication and an overview of the variations in production conditions between the selected countries.

1.2 The importance of agriculture in Australia, France, New Zealand, Norway and the USA

In economical terms, the USA, France and Australia are three of the world's ten largest exporting nations of agricultural commodities (appendix 1). According to FAO (1999), the USA exported $62.5 billion worth of agricultural commodities in 1997, of which grain and meat accounted for approximately 18 and 10 percent, respectively. USA´s agricultural exports account for about 14 percent of the total world exports of agricultural commodities. In the same year, Norway exported agricultural commodities equivalent to approximately $536 million, which represents a share of the total world exports of about 0.1 percent.

New Zealand's export volume is considerable relative to the country's share of the world's total acreage of cultivated land (4.3 percent of the world's meat export in 1997). The major agricultural products are wool, meat and dairy products. New Zealand is the world's largest exporter of sheepmeat and dairy products and the second largest exporter of wool (OECD 1998a). Australia is the leading wool producer, and its export of grain and meat account for 10.1 and 5.5 percent of the world's grain and meat exports, respectively.

France is one of western Europe's major agricultural nations, accounting for approximately 10 percent of world grain exports. It is also one of the world's leading exporters of butter and cheese.

Of the countries presented in this study, New Zealand has the highest percentage of agricultural employment (10 percent), followed by Norway, Australia and France (Table 1.1).

Table 1.1 Main agricultural indicators

	Agriculture in GDP (%)[1)]	Agricultural employment of total civilian employment (%)[2)]	Crop output of final agricultural output (%)[3)]	Animal output of final agricultural output (%)[3)]
Australia	2.7	5.1	53.2	46.8
France	2	4.7	50.7	49.3
New Zealand	5.2	9.9	21.7	78.3
Norway	0.9	5.2	26.9	73.1
USA	1.4	2.9	53.5	46.5

Source OECD 1998b.

1) *Average 1994-1996. At marked prices.*
2) *Average 1994-1996. Employment in Agriculture, hunting, forestry and fishing.*
3) *Excluding "Miscellaneous".*

New Zealand´s agriculture accounts for about 5 percent of its gross domestic product (GDP). The corresponding figure for Norway is 0.9 percent.

Norway and New Zealand distinguish themselves by having most of their agricultural output originate from livestock products (73 and 78 percent of final agricultural output, respectively). In Australia, France and the USA, agricultural output is more evenly divided between livestock and crop production.

2 Natural conditions

Natural conditions such as climate, topography, soils, etc. limit the extent of agricultural production in any given country. A survey of the importance of natural conditions for agricultural production should elucidate all of these factors and the complicated interactions between them. However, this could not be achieved within the scope of this project, and we have therefore limited the study to climatic and topographic conditions.

2.1 Climate

The climate data presented in this report was obtained from weather stations in the respective countries. Whenever possible, we have chosen weather stations in farming regions, with emphasis on grain (wheat), dairy, cattle and sheep production (appendix 2).

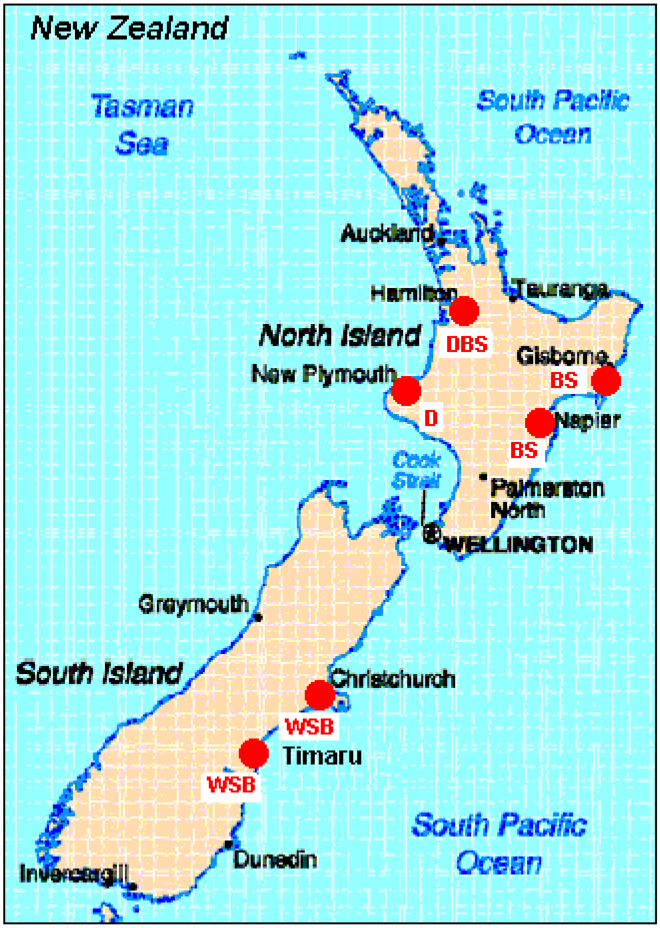
Approximately seven stations were chosen in each country, and in Australia and the USA each station necessarily represents a large region. In Figure 2.1 the stations' geographical distribution is shown, in addition to the respective regions' major products. In Norway, New Zealand and France a somewhat higher weather station density was chosen, due to greater climatic variations within relatively short distances (which in turn are due to factors such as hilly and mountainous terrain and extensive coastlines). Nevertheless, the data gives a general overview over climatic differences between the countries.

In agroclimatic terms, the most important factors for crop production are radiation (energy), temperature and moisture. The amount of radiation determines production and evaporation. The crops' water supply is determined by the amount and the temporal distribution of precipitation, the soil's water-holding capacity, evaporation and the plants' above- and underground development (Samnordisk planteforedling (SNP) 1992).

According to Pearson (1992), the amount of radiation is sufficient for plant production on most of the earth's surface, whereas temperature and available moisture represent the major limitations.

In Norway, France and the USA, temperature is a growth-limiting factor, and in some regions, night frost, late spring frost and early autumn frost can create difficulties. On the other hand, radiation and temperatures can be so high in Australia and New Zealand that plant growth is inhibited. In Australia, large areas are subject to drought, and rainfall is thus of major importance.

It has been difficult to obtain certain agroclimatic data. We have therefore chosen to calculate common climatic parameters such as length of growing season, temperature sum, mean temperature and mean precipitation.



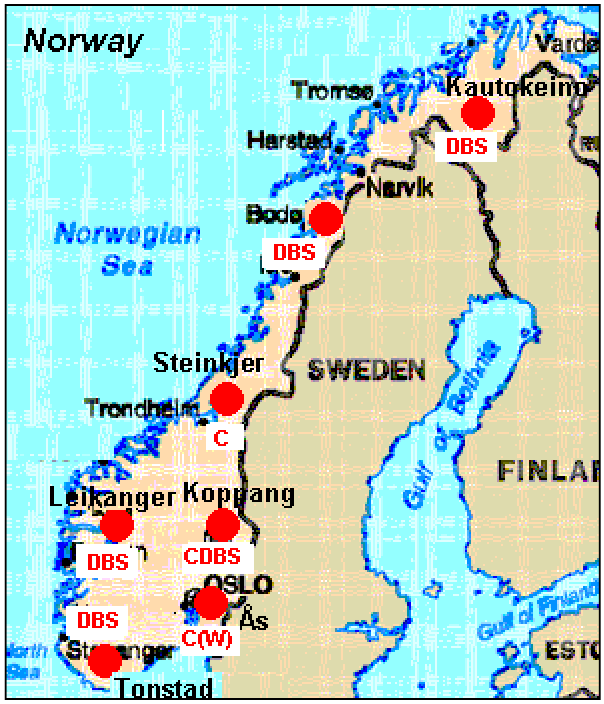
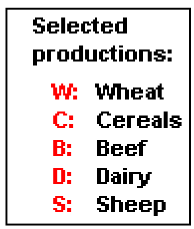


Figure 2.1 Weather stations for climate data

The maps are shown on different scales.



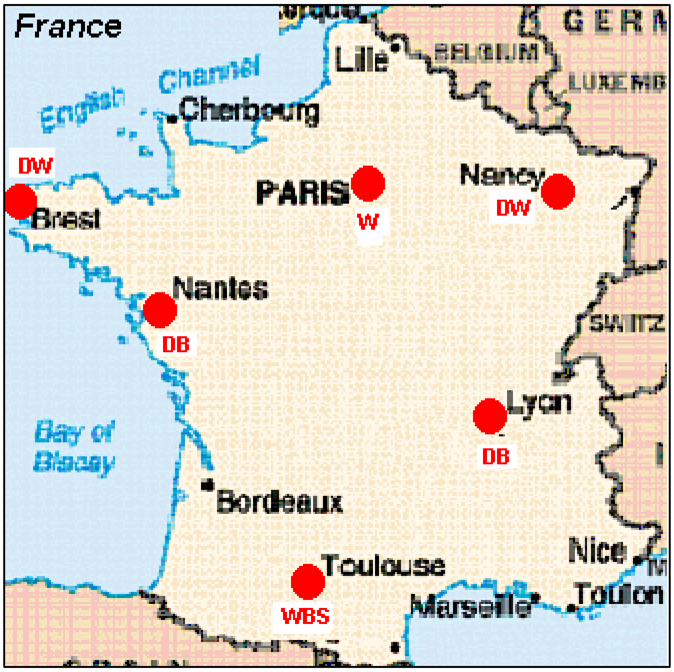


Figure 2.1 (contd.) Weather stations for climate data
The maps are shown on different scales.

Selected productions:

- W: Wheat
- C: Cereals
- B: Beef
- D: Dairy
- S: Sheep

Figure 2.1(contd.) Weather stations for climate data
The maps are shown on different scales

Selected productions:

- **W:** Wheat
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2.1.1 Growing season

The growing season is defined as the number of days per year with a mean temperature above 5°C (5°C is the internationally accepted limit). The length of the growing season can be used as a measure for a region's crop production potential in France, Norway and the USA, since temperature in these countries is a marginal, growth-limiting factor. However, the number of days with a mean temperature above 5°C is no good indicator of the crop production potential in Australia and New Zealand. In these countries, high temperatures may be growth-limiting, if at all, and other factors such as rainfall and evaporation are of greater importance.

The length of the growing season in France, Norway and the USA is shown in Table 2.1. In Australia, the mean temperatures at the selected stations are above 5°C during the entire year, and in New Zealand only one station (Timaru) had a mean temperature of below 5°C, from 21 June to 07 July.

Of the wheat growing regions in France, Norway and the USA, France has the longest growing season, which, in the Paris region, begins about one month earlier than in Norway (Ås) and Midwestern USA. The length of the growing season in the Paris region is 281 days, followed by Norway's south-east (Ås) with 235 days and the American Midwest, with 210–230 days.

However, plants in northern latitudes require some time to prepare for the winter, in which they produce food reserves instead of continuing to grow. The actual growing season in these areas (resulting in growing crops) is thus shorter than indicated in the table.

The length of the growing season also disregards the effects of coastal climate. In spite of its northern latitude, Norway's coastal region has a relatively long growing season, but nevertheless low average temperatures (appendix 3). In Norway one often uses 6 °C as the limit for determining the growing season, since this often coincides with the spring thaw.

Table 2.1 Growing season (dates and number of days)

Country	Weather station	Period with mean temp. ≥ 5°C (dates-day/month)	Number of days
France	Brest	01.01 – 31.12	365
	Paris	26.02 – 03.12	281
	Nancy/Essey	13.03 – 14.11	247
	Nantes	22.01 – 02.01	311
	Lyon/Bron	23.02 – 28.11	279
	Toulouse/Blagnac	21.01 – 08.12	322
Norway	Ås	26.03 – 15.11	235
	Koppang	08.04 – 27.10	203
	Tonstad-Nettfed	23.04 – 28.10	189
	Leikanger	15.04 – 30.10	199
	Steinkjer	27.04 – 16.10	173
	Bodø	02.05 – 18.10	171
	Kautokeino	24.05 – 16.09	116
USA			
West	Sacramento (California)	01.01 – 31.12	365
	Glasgow (Montana)	08.04 – 23.10	199
Midwest	Huron (South Dakota)	03.04 – 29.10	210
	Grand Island (Nebraska)	22.03 – 08.11	232
	Minneapolis (Minnesota)	03.04 – 01.11	213
	Peoria (Illinois)	26.03 – 13.11	233
South	Dallas (Texas)	01.01 – 31.12	365
Northeast	Harrisburg (Pennsylvania)	15.03 – 23.11	252

2.1.2 Temperature sum and mean daily temperature

The temperature sum is the climate index most commonly used to characterize temperature conditions for agricultural and horticultural crops. A high temperature sum (accumulated temperature) indicates good growing conditions. The temperature sum is defined as the sum of the daily differences between the mean daily temperature and a minimum threshold temperature (5^{o}C) within the growing season. The temperature sum has the advantage of taking into account both temperature and the length of the growing season. It gives a good indication of the growth potential in areas in which temperature is a minimum factor. We have chosen to also include data from Australia and New Zealand, in order to illustrate the significant climatic difference between these countries and France, Norway and the USA. **Feil! Ugyldig selvreferanse for bokmerke.** presents the annual temperature sum for selected wheat growing areas in each of the countries, even though conditions vary between different wheat growing areas within each country as well.

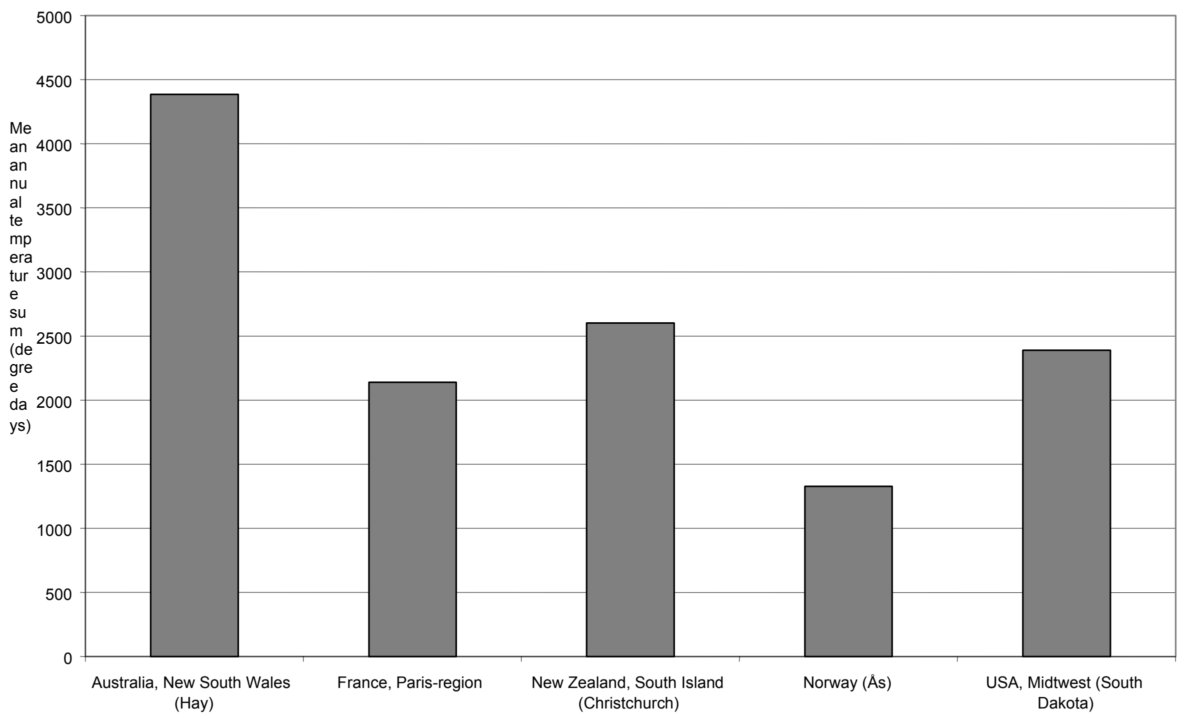


Figure 2.2 Mean annual temperature sum (as degree days) in selected wheat growing areas

The Paris region has an annual temperature sum of 2140 degree days, whereas the corresponding figures in the USA are 1858, 2390 and 2799 degree days in Montana, South Dakota and Nebraska, respectively. In Ås, Norway, the annual temperature sum is 1327 degree days. The monthly distribution of degree days and temperature sum shows that France has a milder climate and less climatic variation throughout the year than the USA and Norway. In **Feil! Ugyldig selvreferanse for bokmerke.** the mean daily temperatures from March to November are shown for the Paris region, Ås (Norway) and South Dakota. Of these three areas, only the Paris region has a mean temperature sum of more than 0 degrees in March and November (**Feil! Ugyldig selvreferanse for bokmerke.**).

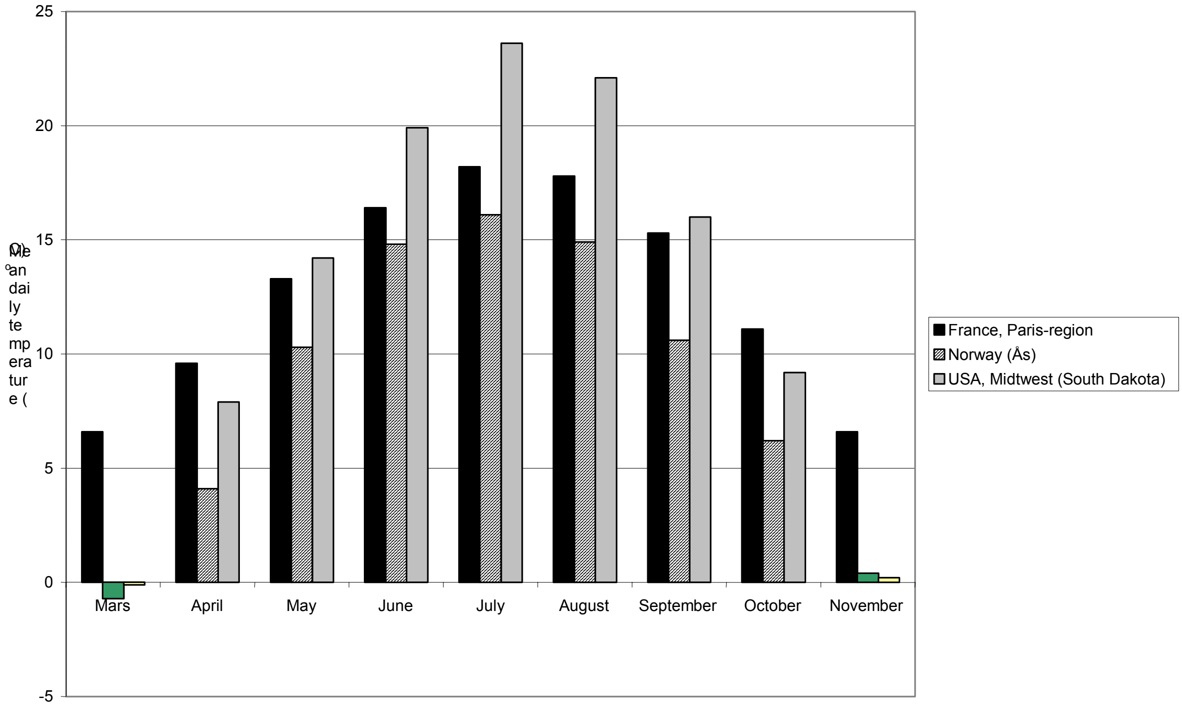


Figure 2.3 Mean daily temperature (°C) from March to November in selected wheat growing areas

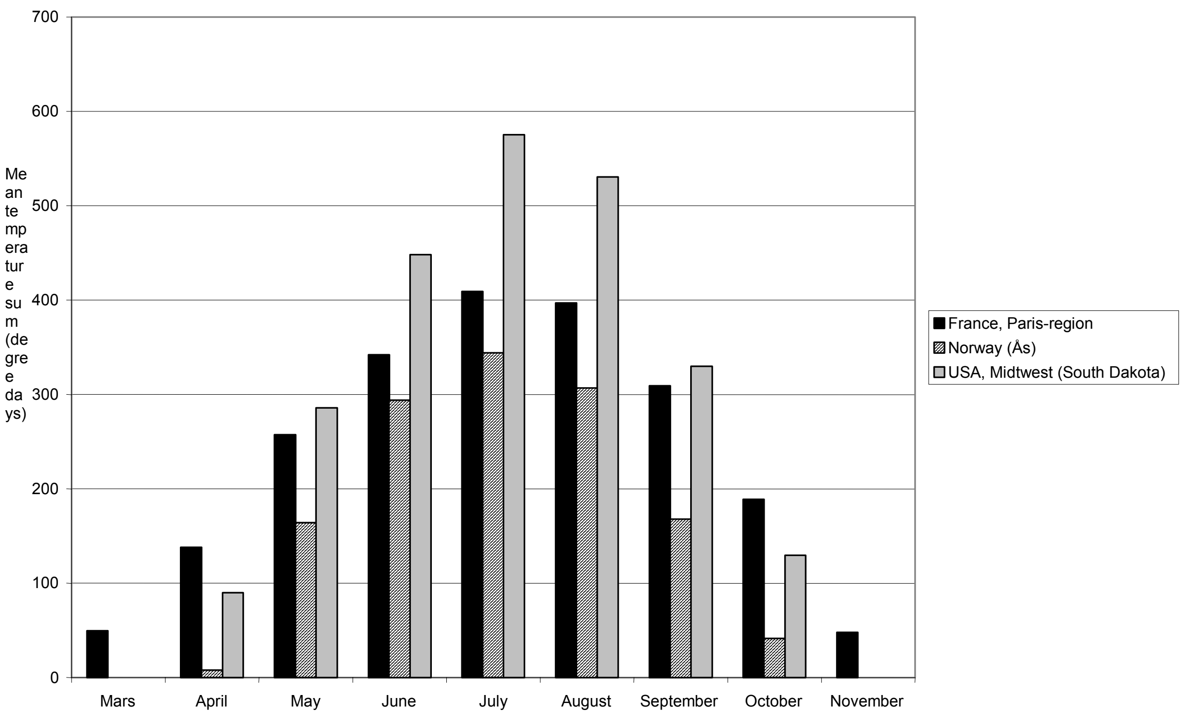


Figure 2.4 Mean temperature sum (as degree days) from April to October in selected wheat growing areas

In several places in Australia, the temperature sums during winter are about the same as in Norway during summer. New Zealand also has high temperature sums during winter. The data on mean daily temperatures (appendix 3) underlines the climatic differences between Australia and New Zealand on one hand, and France, Norway and the USA on the other.

Not only does the favourable climate in Australia and New Zealand imply good conditions for crop production, it also enables livestock to graze throughout the entire year. According to IFCN (1998), the climate is ideal for high-yielding, clover-based grassland husbandry, with little use of feed concentrates. The length of the grazing period in Western Norway (Leikanger) and Southern Norway (Tonstad) is about 90 and 112 days, respectively. Grazing in these areas usually starts in late May or early June (Landbruksdepartementet 1992).

2.1.3 Frost and snow

Harsh winters with frost and snow cover limit crop and livestock production.

The overwintering conditions affect the growth of many plants. "The climatic influence on overwintering starts in the preceding summer and autumn with growth cessation, accumulation of reserves and hardening. It continues during the winter with dehardening, rehardening, the impact of frost, the creation of conditions conductive to water and ice damage, attacks by wintering fungi, and a general exhaustion of reserves by time" (Skjelvåg 1998:155).

Ground frost often results in moist, cold soils and delayed sowing, and can have adverse effects on crop yield and quality. Risk factors such as night frosts, late spring frosts and early autumn frosts always represent a threat to crop production. In 1998, the annual losses due to winter grassland damage in Norway were estimated at NOK 94 million (SNP 1992).

However, one must not forget that a warm climate also can have negative effects on crop production, e.g., by creating favourable conditions for crop diseases and pests.

Low temperatures and snow cover limit the length of the grazing season. Low temperatures also have an impact on the operation and maintenance of farm buildings, storage facilities, heating systems, etc.

In contrast to Norway and the USA, the selected farming regions in France, Australia and New Zealand do not have any months at all with average temperatures below $0^{o}C$ (appendix 3). Data on snow cover was only available for Norway (Table 2.2).

Table 2.2 Average number of days with snow cover in Norway

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Pct	Nov	Dec	Year
Ås	24.9	24.0	22.4	7.1						0.5	5.1	16.5	100.5
Koppang	30.4	28.3	30.5	16.1	0.7				0.1	2.4	22.3	27.9	158.7
Tonstad	25.1	22.3	20.5	4.8						0.1	2.5	11.2	86.5
Leikanger	22.2	21.5	14.5	2.9						0.8	3.4	11.2	76.6
Steinkjer	23.1	21.6	22.9	9.1	0.6					1.7	5.8	14.7	99.5
Bodø	20.0	17.0	17.5	9.4	0.4					1.5	5.5	14.4	85.7
Kautokeino	31.0	28.3	31.0	26.5	8.2					9.0	24.2	30.6	188.8

2.1.4 Precipitation

As earlier mentioned, a crop's water supply depends on the amount and distribution of precipitation, the soil's water-holding capacity, evaporation, etc. Total precipitation data thus does not give a complete picture of the water supply. The average annual precipitation in selected wheat growing areas in the different countries is shown in **Feil! Ugyldig selvreferanse for bokmerke.**. However, the amount of precipitation varies considerably within each country, and is not evenly distributed throughout the year (appendix 5).

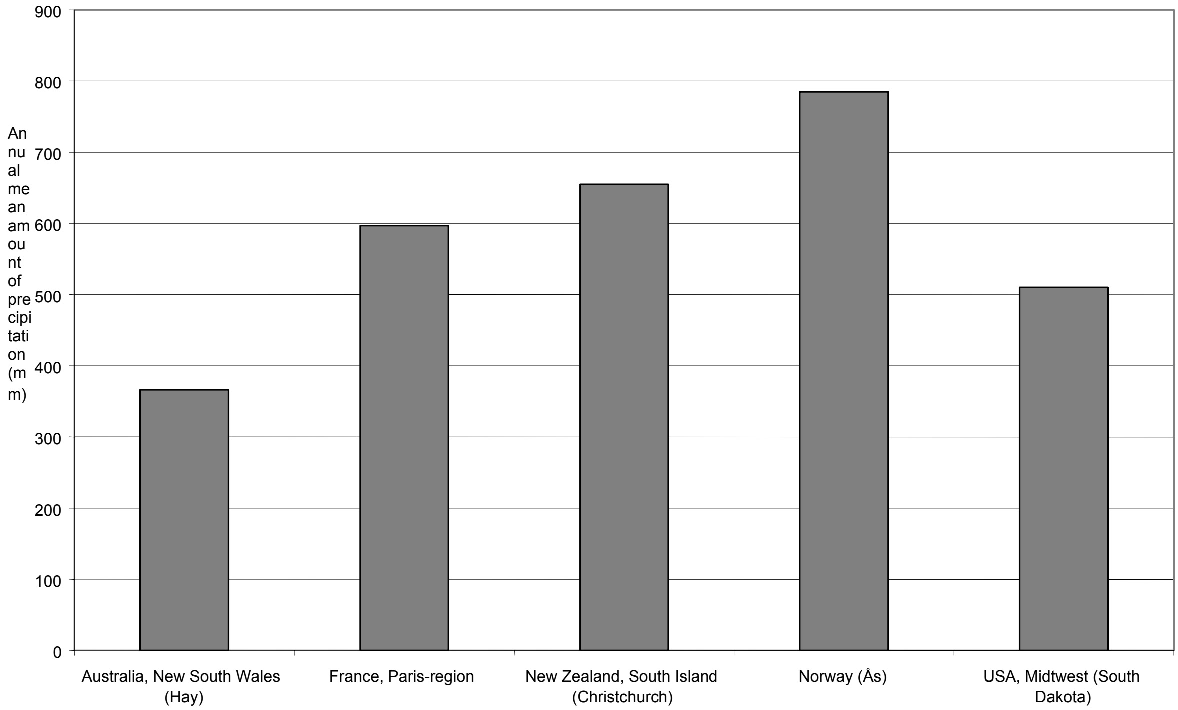


Figure 2.5 Annual precipitation (mm) in selected wheat growing areas

The presented data does not reflect the significant regional differences that can exist with regard to precipitation. In Norway, e.g, there are some extremely dry areas (often shaded by high mountain areas to the west), and on the other hand there are areas in southern and western Norway with a significant precipitation surplus.

In addition to being a limiting factor for plant growth, precipitation also influences crop production in other ways. "Various operations in crop production are best carried out when it is not raining. The cost due to suboptimal timing of such operations is a function of weather, crop and technical equipment" (Skjelvåg 1998:155).

Precipitation also impedes harvesting. In the wheat growing areas of south-eastern Norway, there is relatively much rain (80–100 mm per month) in the months of August, September and October. In the wheat growing areas in France, precipitation is more evenly distributed throughout the year, and in the harvest season the amount of rainfall is about 45–60 mm per month. In Australia (Hay), monthly rainfall averages 25–35 mm during the entire year, whereas precipitation in New Zealand (Christchurch) is higher and shows greater temporal variation. In the USA, rainfall in the harvest period varies between the different regions, e.g., about 35–70 mm per month in Nebraska, 40–50 mm per month in South Dakota and 7–25 mm per month in Montana. The data presented here only shows the monthly distribution of total precipitation. However, in addition to the amount of precipitation, its frequency, intensity and duration are also of importance.

The duration of the grazing period in Norway is initially limited by the length of the growing season. However, water-logged soils, as a result of heavy rainfall and poor drainage, reduce the soil's bearing capacity and makes it more susceptible to compaction. This can further reduce the length of the grazing period in both spring and autumn (Langøren 1997). During the main grazing period in the months of June, July and August the average rainfall in Norway varies from 100 to about 800 mm (Opsahl 1984).

2.2 Topography

The use of farmland is influenced by its topography, i.e., field shape, size and slope. Modern, efficient farming methods based on intensive use of large farm machinery require relatively level and large areas. Hillside farming is not only more difficult, but the risk of erosion also is much greater on slopes.

In Norway, mountains, hills and rocks, forests, etc. form natural limits to how large fields can be. A typical farm in the forested districts of southern and eastern Norway is shown in Figure 2.6.

Figure 2.6 A farm in the forested districts of southern and eastern Norway, Birkenes in Aust-Agder
Photo: Oskar Puschmann

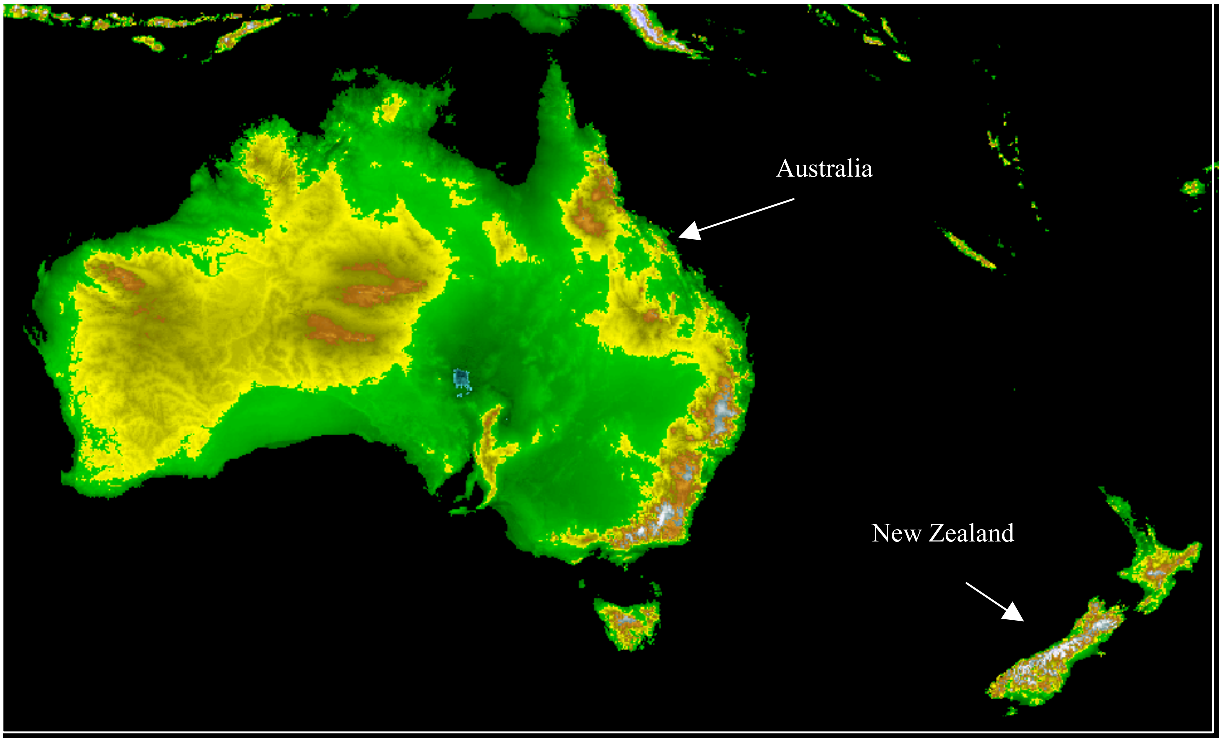
There are a number of sources of topographical information (maps and other data), but it goes beyond the scope of this project to gather, process and compare data on slope gradients and land consolidation[1]. Furthermore, one may ask to what degree such a

[1] "Agriculture, Answers to the questionnaire on Agriculture; Norway's request for accession to the EC" (LD 1992) includes an overview of field sizes and farmland classified by slope gradient classes. See appendix 6.

detailed comparison is necessary in connection with a cost analysis, considering the countries' tremendous geographical differences with regard to farmland acreage and topography.

In order to illustrate the large topographical variations between the countries, we have chosen to present maps published by the National Geophysical Data Centre (NGDC 1999).

The maps are shown on different scales. Dark green colour indicates lowlands, followed progressively by light green, yellow, brown, and white, which represents the highest elevations.



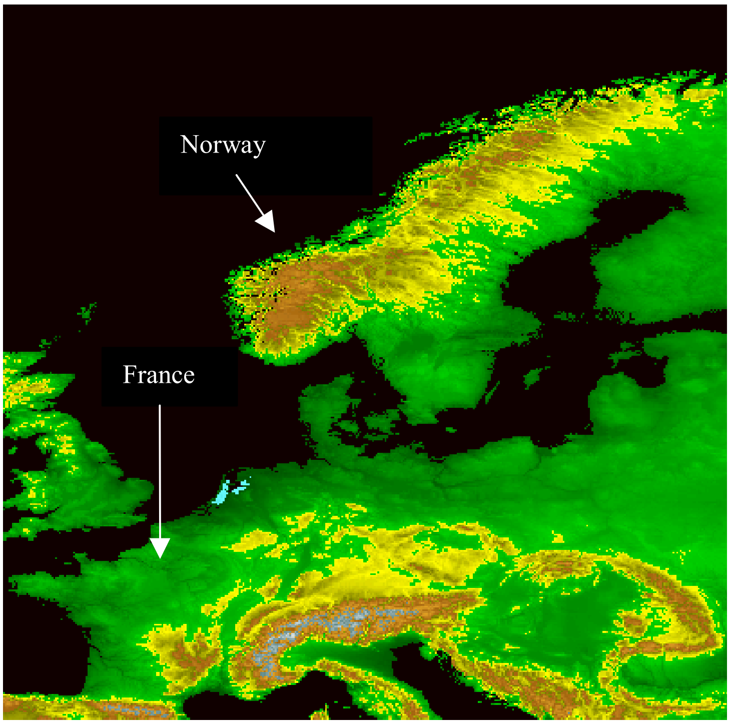


Figure 2.7 Topographical maps

Source: NGD 1999

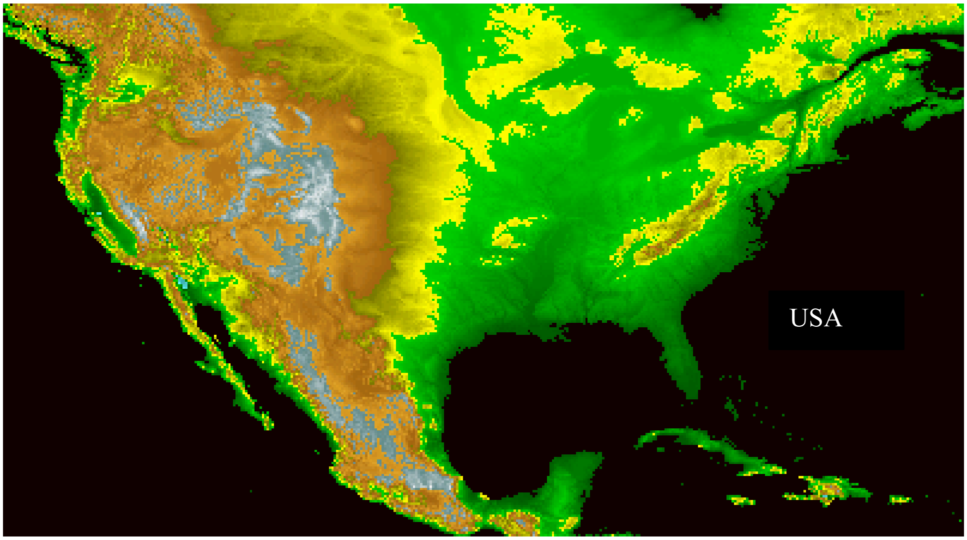


Figure 2.7 (contd.)   Topographical maps

Norway and New Zealand can be distinguished by the large percentage of the land area which is covered by mountains (Figure 2.7). In the USA, there are extensive mountain ranges in the west, whereas France has mountain regions in the southeastern part of the country[2]. Australia is a relatively flat country with an average elevation of slightly more than 200 meters above sea-level (ABS 1998b). In Norway, approximately 60 percent of the land area lies below 600 meters above sea-level (SSB 1997), compared to 95 percent in Australia (Aschehoug & Gyldendal 1989)[3].

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[2] The mountainous areas in France are classified as "Less favoured areas" by the EU (LFA), and agriculture in these areas thus receives additional support. See the map showing LFA-areas in appendix 7.

[3] The growing conditions at different elevations also depend on the latitude.

3 What are the effects of varying natural conditions on agriculture?

In the previous chapter we have taken a look at some of the natural conditions that have an impact on agricultural production. In this chapter we will attempt to elucidate what the consequences of these natural conditions are for agricultural production. We have already mentioned that agricultural production is additionally influenced and limited by other factors than nature, such as politics, laws, economy, cultural and historic aspects. The data presented in this chapter is thus a result of the interaction between all of these factors, but is also indirectly an indicator of the natural basis for agricultural production.

3.1 Land use distribution

The relative share of agricultural land of a country's total land area is an indication of how much of a country's surface area can be utilized for agriculture. This figure reflects, *inter alia*, topography, soil quality, climate, etc. This chapter is based on data from the FAO, supplemented with data from other sources. The total land area and land use distribution of countries vary, depending on the information source one uses.

In Australia, New Zealand and France agricultural land use dominates, covering 60, 56 and 55 percent of the total land area, respectively (Table 3.1). In the USA, about 46 percent of the total area is farmland, and in Norway only 3 percent. It must be mentioned that the rough grazing areas in Norway's mountainous regions are not defined as agricultural land.

Table 3.1 Land use distribution

	Total surface (km2)1)	Land area (km2)2)	Water area (km2)3)	Total agricultural area (1000 ha)4)	Agricultural area/total land area (%)	Agricultural area (1000 ha), based on the countries' own statistics	In operation (1000 ha)10)
Australia	7 741 220	7 682 300	58 920	464 721	60.5	466 152 5)	..
France	551 500	550 100	1 400	30 029	54.6	30 215 6)	29 346
New Zealand	270 530	267 990	2 540	14 979	55.9	14 979 7)	14 901
Norway	323 880	306 830	17 050	1 030	3.4	1 038 8)	1 038
USA	9 363 520	9 159 120	204 400	420 250	45,9	387 655 9)	383 518

Source: FAO 1995 and FAO 1998

1) *The total land area of the country, including area under inland bodies of water.*
2) *Total area excluding area under inland bodies of water. The definition of inland bodies of water generally includes major rivers and lakes.*
3) *The differance between 1) and 2)*
4) *Total agricultural area. Including arable land, permanent crops and permanent pasture. For New Zealand, the figure is based on data from SNZ (Statistics New Zealand).*
5) *Total area of establishments with an EVAO (Estimated Value of Agricultural Operations) of $ 5,000 or more (per 1997). Source: ABS (Australian Bureau of Statistics) 1998a.*
6) *Total area used for crop production, which is exhaustively described as: Arable land including temporary grazing and fallow and green manure, permanent grassland, land under permanent crops, crops under glass and other utilised agricultural areas (per 1997). Source: Eurostat 1998.*
7) *Total area used for crop production, which is exhaustively described as: Arable land including temporary grazing and fallow and green manure, permanent grassland, land under permanent crops, crops under glass and other utilised agricultural areas (per 1995). Source: NZS 1997a.*
8) *Refers to holdings with at least 0.5 hectares agricultural area in use (per 1997). Source: SSB (Statistisk sentralbyrå) 1998.*
9) *Land in farms: consists primarily of agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm operator`s total operation (per 1992). Source: US Bureau of The Census 1997.*
10) *Estimation based on data from Eurostat 1998, USDA (United States Department of Agriculture) 1998, U.S. Bureau of the Census 1997, SNZ 1997a and SSB 1998.*

According to FAO (1999), a large share of the agricultural area in Australia (90 percent) and New Zealand (78 percent) is classified as "wild prairie or grazing land" (permanent pasture Table 3.2). Such vast, extensively used grazing land can also be found in the USA. Ranch farming is common, especially in western USA, Australia's semi-desert interior regions and New Zealand´s South Island highlands (Burger 1994). In France and Norway, however, arable land used for temporary crops or temporary meadows for mowing or pasture represents the lion's share of the total agricultural area.

Table 3.2 Distribution of agricultural land

	Permanent pasture (1000 ha)[1)]	Permanent pasture/agri-cultural area (%)	Arable land (1000 ha)[2)]	Arable land/agri-cultural area (%)	Permanent crops (1000 ha)[3)]	Permanent crops/total agricultural area (%)
Australia	414 500	89.2	50 011	10.8	210	0.0
France	10 568	35.2	18 288	60.9	1 173	3.9
New Zealand	11 701	78.1	1 558	10.4	1 720	11.5
Norway	129	12.5	901	87.5	0	0.0
USA	243 250	57.9	175 000	41.6	2 000	0.5

Source: FAO 1995 and FAO 1998.

1) *Permanent pasture: land used permanently for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land).*
2) *Arable land: land under temporary crops, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow.*
3) *Permanent crops: land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest.*

3.2 Cereal production

The percentage of cereal acreage of a country's total agricultural area is an indication of the farming conditions in a given area (climate, soil, etc.). The relative share of cereal acreage of the total cultivated area (arable land and permanent crops) is shown in Table 3.3. Areas used as permanent pasture are not included in the calculation, since these areas often cannot be transformed to arable land. In addition, FAO has stopped including these areas in production statistics in 1995.

A relatively large share of the arable land in Norway is used for cereal growing (wheat, barley, oats and rye), but also in Australia and France cereals are grown on more than 30 percent of the arable land. Maize (corn) is a major crop in both France and the USA, grown on approximately 9 and 17 percent, respectively, of the arable land.

Table 3.3 Distribution of cereal acreage

1998	Harvested cereal acreage[1)] /arable land and permanent crops (%)	The share of cereal acreage of arable land and permanent crops (%)				
		Wheat	Barley	Oats	Rye	Total
Australia	32.4	22.8	5.9	1.6	0.1	30.4
France	47.3	26.9	8.3	0.7	0.2	36.2
New Zealand	4.8	1.6	2.2	0.4	0.0	4.1
Norway	37.0	8.3	17.5	10.7	0.4	37.0
USA	34.8	13.5	1.3	0.6	0.1	15.6

Source: FAO 1999.

1) *Cereals include wheat, barley, rye, oats, millet, sorghum, buckwheat, triticale, canary seed, mixed grain, rice (paddy), maize and cereals nes.*

Wheat is grown on a smaller share of the cultivated land in Norway than in France, Australia and the USA. Wheat yields are higher in Norway than in Australia and the USA, but lower than in New Zealand and France. When dividing the total wheat production by the total arable land area, Norway has about the same level of production as Australia and the USA, whereas France's wheat production per hectare arable land is about five times as high. New Zealand produces only 82 kg/ha arable land (Table 3.4).

Table 3.4 Wheat production and yields

	Wheat (1000 ha)1)	Wheat (1000 tonn)2)	Wheat yields (kg/ha)2)	Wheat production/ total arable acreage (kg/ha)
Australia	11 460	17 932	1 758	357
France	5 243	34 208	6 907	1758
New Zealand	51	270	5 472	82
Norway	75	297	4 530	330
USA	23 878	64 300	2 580	363

Source: FAO 1999.

1) 1998-data
2) Average 1994–1998.

However, high yields are not only a result of favourable natural conditions. The use of inputs also has considerable influence on the yield level. According to Grigg (1984), the financial input and choice of technology is related to the agricultural population density. Farmers with access to large areas, e.g. in the USA, Australia and New Zealand, achieve large surpluses even if yields per hectare are low. "They concentrate on maximum output per capita, spend much on labour-saving machinery and less on yield-increasing inputs" (Grigg 1984:92). In countries with a high agricultural population density another strategy dominates. Farmers here select those enterprises that give a high return per hectare, and will spend much on inputs that increase crop yields, such as fertilizers, pesticides and herbicides (Grigg 1984).

Maize, paddy rice and wheat are the cereals that require most warmth (pers. comm. Skjelvåg), and there is thus a limit as to how far north these crops can be cultivated. The share of the total cereal acreage used to grow these species is therewith an indicator of the climate-related growing conditions. Maize and paddy rice are so-called tropical cereals, and in the USA these are grown on about half of the total cereal acreage (Table 3.5). In France and New Zealand, maize and paddy rice account for 19 and 12 percent of the total cereal acreage, respectively. In Australia, USA and France, wheat is grown on about ¾ of the temperate cereal acreage, in Norway wheat accounts for less than one quarter of the cereal acreage. Maize, paddy rice and wheat are grown on approximately 90 percent of the total cereal acreage in the USA, on more than 70 percent in Australia and France, and on about 40 and 20 percent in New Zealand and Norway, respectively.

Table 3.5 Cereal production

1998	Cereals (1000 ha)	Temperate cereals (1000 ha)1)	Wheat (1000 ha)	Tropical cereals (1000 ha)2)	Tropical cereals/ cereals (%)	Wheat/ temperate cereals (%)	Tropical cereals & wheat/ cereals (%)
Australia	16 275	16 084	11 460	191	1.2	71.3	71.6
France	9 205	7 415	5 243	1 790	19.4	70.7	76.4
New Zealand	156	138	51	18	11.5	37.0	44.2
Norway	333	333	75	0	0.0	22.5	22.5
USA	61 543	30 819	23 878	30 724	49.9	77.5	88.7

Source: FAO 1999.

1) *Cereals excl. maize and rice (paddy)*
2) *Maize and rice*

3.3 Livestock production

Livestock production is limited by factors such as available grazing land, farm size, economy, agricultural policy, etc. Table 3.6 shows the number and distribution of cattle, dairy cows and sheep in the different countries.

Table 3.6 Number of domestic animals

	Cattle (1000 head)	Dairy cows (1000 head)	Dairy cows/cattle (%)	Sheep and lambs (1000 head)
Australia1)	26 780	1 977	7.4	120 228
France2)	20 905	4 197	20.1	9 823
New Zealand3)	9 272	2 630	28.4	48 816
Norway4)	1 018	314	30.9	2 448
USA5)	101 460	9 309	9.2	7 937

1) *As of March 1997 (ABS 1998a)*
2) *Cattle as of May/June 1997, sheep as of December 1997 (Eurostat 1998)*
3) *As of 30 June 1995. Dairy cows include heifers in milk or calf. (SNZ 1997).*
4) *As of June 1997 (SSB 1997)*
5) *As of 01 January 1997 (USDA 1998)*

3.4 Farm size distribution

The size and structure of farms are influenced by a number of factors such as politics, economy, property laws, technology and natural conditions. As shown in **Feil! Ugyldig selvreferanse for bokmerke.**, natural conditions are an important factor with regard to farm size variations. Topography, geology, soil quality, etc. can limit the possibilities for the increase of farm size, often necessary for the use of modern and efficient farm machinery.

Australia has the largest farms, with an average farm acreage that is 347 times larger than an average Norwegian farm. However, farm size varies considerably from region to region, and between different types of production. In Australia, the intensively run farms along the coast often have 150–300 ha, whereas the inland cattle ranches can be as large as 2,000 to 600,000 ha (Burger 1994). In Norway, the largest farms lie in the two south-eastern counties of Østfold and Akershus, with average farm sizes of 22 and 20 ha, respectively. The smallest holdings are to be found in the western Norwegian county of Hordaland, on average 7,5 ha (SSB 1998). An average-sized sheep farm in New Zealand has 580 ha, an average dairy farm about 115 ha and mixed-livestock farms average 400 ha (SNZ 1997).

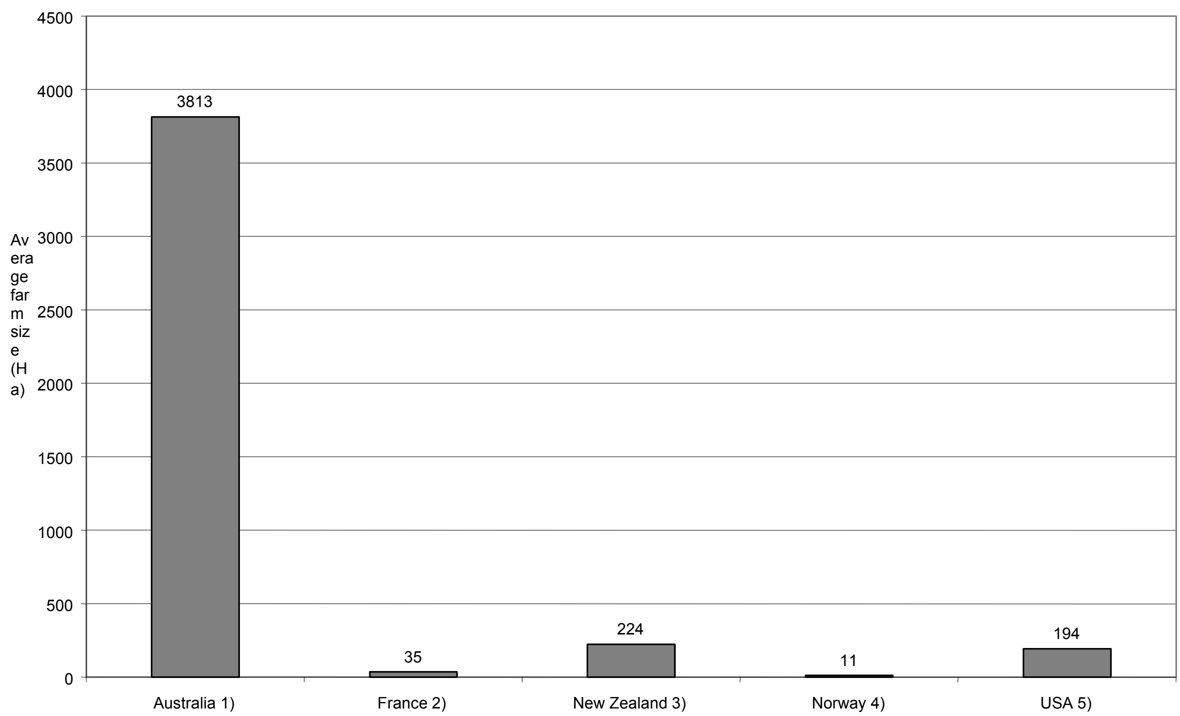

Figure 3.1 Average farm sizes

Adapted from OECD 1998a.

1) *As of 1990.*
2) *As of 1993. According to Eurostat (1998) it was 38.5 ha in 1995.*
3) *As of 1990.*
4) *As of 1993. According to SSB (1998) it was 13.1 ha in 1997.*
5) *As of 1993. According to USDA (1998) it was 192.7 ha in 1997*

The relative farm size distribution for those countries for which data was available is shown in Table 3.7. The figures for the USA are converted from acres.

In Norway, more than 80 percent of the farms are smaller than 20 ha. Corresponding figures in France and the USA are nearly 50 percent and 30 percent, respectively. The majority of farms in Norway are between 5 and 20 ha. The size of farms in France is more evenly distributed. In Australia, less than 20 percent of all farms are smaller than 50 ha, most farms are between 100 and 500 ha, while approximately 30 percent are evenly distributed among farms with between 500 and 5000 ha. A significant share of the farms in the USA are also large.

Table 3.7 Relative farm size distribution (in %. Farm size in ha)

Hectares	< 5	5–19.9	< 20	20–49.9	< 50	20–73	> 50	50–99.9	> 100	73–205	100–499.9	206–820	500–999.9	> 820	1000–4999.9	> 5000
Norway	26.3	54.5	80.8	17.6	98.4		1.6									
France	27.3	21.5	48.8	24.1	79.2		27	17.4	9.6							
Australia					19.5		80.5	11.6	68.9		34.0		13.2		16.5	5.2
USA			29.5			31.0				21.1		14.5		3.9		

Source: Eurostat (1998), SSB (1998), ABS (1998a) and NASS (National Agricultural Statistics Service) (1999a).

According to Burger (1994), 54 percent of all farms in New Zealand have between 40 and 250 ha, and 1 percent is larger than 2000 ha.

We have calculated the average herd size and wheat acreage per farm, as well as the number of holdings per area unit farmland. Appendix 8 shows the distribution of farm types used in the calculations. The data should be used cautiously, since they originate from statistical sources from each of the countries[4], with varying methods for developing and presenting such statistics. Nevertheless, the data gives a good indication of the variations between the countries.

Norway has much fewer cattle, sheep and dairy cows per holding than the other countries (Table 3.8). Herd sizes in France are also much smaller than in Australia, New Zealand and the USA. Australia has the largest number of cattle per holding, while New Zealand has the largest dairy cow and sheep herds per holding.

There are also significant differences with regard to the number of holdings per 100 km^2 agricultural land. Norway, with the highest farm density on agricultural land, has more than 246 times more farms per 100 km^2 than Australia.

Table 3.8 Average herd sizes and number of holdings per 100 km^2 farmland

	Cattle/holding (head)	Dairy cow/holding (head)	Sheep/holding (head)	Holding/100 km^2
Australia	301.6	139.3	2702.7	3.1
France	63	26.5	98.2	243.2
New Zealand	281.1	190	2916.8	44.6
Norway	31.9	13.8	96.2	763.4
USA	86.9	79.8	106.2	53.1

Statistics on the number of farms growing wheat were only found for France, Norway and the USA (appendix 8). We calculated the average wheat acreage per wheat-growing unit, and the largest acreage per wheat farm was in the USA (106 ha), compared to 9 ha and 18 ha per unit in Norway and France, respectively (**Feil! Ugyldig selvreferanse for bokmerke.**).

Farm sizes often vary between different wheat-growing regions in each country. For example, wheat acreage on wheat farms in Montana (USA) averages 290 ha. In Norway,

[4] Australian Bureau of Statistics, Statistics New Zealand, U.S. Bureau of the Census, National Agricultural Statistics Service, Eurostat and Statistics Norway.

Oslo and the county of Hedmark are above average, with 12 and 11 ha, respectively, wheat acreage per wheat-growing farm (appendix 9).

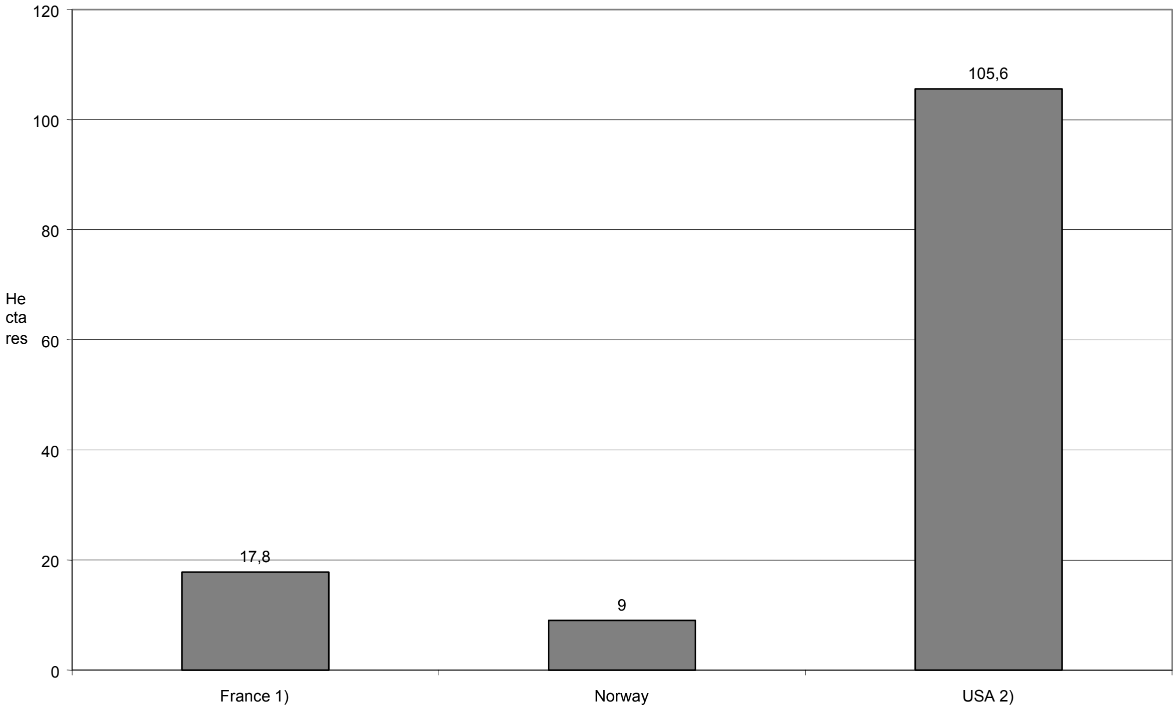

Figure 3.2 Average wheat acreage per wheat-growing farm
1) Exclusive durum wheat
2) Inclusive durum wheat

Source: Eurostat datashop v. SSB, Pers. comm. Bjørlo (SSB), NASS 1999b

Table 3.9 shows the relative distribution of dairy farms by herd size. Even though the countries have different divisions into herd size groups, the data nevertheless gives a general picture of the differences between the countries. Norway's dairy farming is predominantly small-scale, and nearly 90 percent of the dairy farms have herds of less than 20 dairy cows. In France, 67 percent of the dairy farms have more than 20 milking cows. The USA has a more even distribution of herd sizes, but somewhat more large dairy farms than France. New Zealand is quite exceptional, with nearly half of its dairy farms having herds of 100 to 200 dairy cows, and more than 40 percent of the farms having more than 200 dairy cows.

Table 3.9 Relative distribution (in %) of dairy farms by herd size

	Number of dairy cows per farm									
	1–9	10–19	> 20	1–29	30–49	50–99	< 99	100–199	> 100	> 200
Norway	36.6	51.7	11.7							
France	12.6	20.0	67.4	55.1	31.8	12.3	99.2		0.8	
USA				28.6	22.5	29.8	80.9		19.1	
New Zealand							12	47	88	41

Source: SSB (1997), Eurostat (1998), USDA (1998) and MAF (1999a).

3.5 Labour input

Labour input in agriculture reflects the degree of rationalization, which in turn is connected to farm size and structure. Total labour input and annual work units (man-years) in agriculture could only be calculated for France and Norway (appendix 10). The labour input per 100 ha farmland in operation is 8.7 man-years in Norway (SSB 1998) and 3.5 man-years in France (Eurostat 1998). In Norway, 95 percent of the work is carried out by the owners and their families, compared to 79 percent in France.

Dairy production in New Zealand is a good example of agricultural labour rationalization. Figure 3.3 shows dairy cows gathered around an automatic feed dispenser. According to the Ministry of Agriculture and Forestry (MAF 1999b), dairy farms, with an average herd size of 190 cows, are usually operated by one or two persons.

Figure 3.3 Feed automat in Hawkes Bay, New Zealand

Source: MAF 1999c.

In 1994, the OECD published socio-economic data from 1986 for its member countries. Such data should always be compared with caution, since the different countries use different definitions, e.g., for classifying "part-time farms", etc. (OECD 1994). Nevertheless, the data gives an indication of the division of labour input in the different countries. Norway stands out from the other countries by the low share of paid workers and the high share of part-time farmers (Table 3.10).

Table 3.10 Employment in agriculture, 1986

		Australia	France	New Zealand	Norway	USA
Farm employment						
Number of workers		397 600	1 503 000	118 500	102 000	7 687 300
Men	%	69.9	65.1	70.8	75	71.9
Women	%	30.1	34.9	29.2	25	28.1
Employment status						
Paid workers	%	35.2	17.5	29.2	9	28.1
Self-employed	%	64.8	82.5	70.8	91	71.9
Full-time	%	78.6	85	75.7	23	70.4
Part-time	%	21.4	15	24.3	77	29.6

Adapted from OECD 1994.

4 Production costs

Since natural conditions limit agricultural production, they also influence production costs. For example, natural barriers such as mountains, rocks, forests, etc. limit the enlargement of fields necessary for the rationalization of agricultural operations. The length of the grazing season is restricted by the climate, and in countries where livestock cannot graze throughout the entire year, feed concentrates are necessary as a supplement. Irrigation is necessary in areas with too little precipitation, and poor soils need nutrient additions in the form of fertilizers if the desirable yield level is to be maintained.

In the following chapter we will take a look at some production costs, especially those important for agricultural production in Norway. Emphasis is placed on estimating the effect of climate on farming operations and the costs associated therewith. As an introduction, however, we wish to present a comparison of agricultural labour costs.

4.1 Labour costs

It has been difficult to obtain comparable data on the cost of labour in the different countries. In those cases where we could obtain standard rates (New Zealand and Norway), we selected those rates most representative for agriculture. For France and the USA wages are calculated on the basis of questionnaires. The data is not fully comparable, but still gives an impression of the existing differences. For France we only found data on average hourly wages for 1994. The hourly pay then was equivalent to about NOK 57, much lower then the NOK 73.65 per hour in Norway in the same year (Table 4.1). According to the 1998 standard rates, skilled labour in New Zealand earns an average of NOK 56.70 per hour. The figure for the USA is based on the average wage of all agricultural employees (field and livestock workers, exclusive agricultural service workers), and amounts to NOK 54.30 per hour in October 1998. The standard rate in Norway is considerably higher, at NOK 85 per hour for skilled workers with more than 4 years experience.

However, other forms of payment (room and board, working clothes, etc.) are not taken into consideration. Such additional payment is common, e.g. in the USA (USDA 1999) and New Zealand (pers. comm. Newman, MWES). Payroll taxes are also not included. According to Forbes (MAF), there are no such taxes in New Zealand. In Norway, payroll taxes vary between 0 and 14.1 percent, depending on the geographical region. In North Dakota, USA, there is a 12 percent payroll tax (Isermeyer et al. 1999).

Table 4.1 Cost of skilled agricultural labour

	NOK (per hour)	
	1998	1994
France	..	56.9
Average, all workers (skilled & unskilled) in 1994: F 44.7		
New Zealand		
Skilled labour (tariff):		
From $13–$15 NZD	52.7–60.8	
$14 NZD	56,7	
Norway		
Skilled, with 4 yrs. experience (tariff)	85.6	73.7
USA		
Average, all workers (skilled & unskilled): $ 7.2 USD	54.3	

Source: USDA 1999, pers. comm. Newman, Agreste 1999, Landbrukets Arbeidsgiverforening et al. 1994 and 1998. Currency conversion rates from the Bank of Norway.

The International Farm Comparison Network (IFCN 1998) compared costs in dairy production in 17 countries, including USA, France, Australia and New Zealand (Norway was not included). The average wage for skilled labour on dairy farms was calculated in the study, and their results for the USA and France disagree with the hourly rates we arrived at (appendix 11). According to Anderson at Texas A & M University (1999), the before mentioned project estimated the hourly rates in the USA ($12–$14) by dividing the labour costs on an average dairy farm ($25,000–$30,000 per year) by the total labour input per farm. However, it was difficult to estimate the actual labour input (number of hours), since there are no standards, and this way of calculating average wages was thus considered as "not being a good solution" (pers. comm. Anderson). For France, the annual wage is divided by an arbitrary number of hours, resulting in an agricultural hourly wage of about US$ 15.

4.2 Costs in dairy farming

In the following, we shall compare costs in dairy farming in Norway with New Zealand/Australia, which have the world's lowest production costs (IFCN 1998). Earlier, NILF has calculated the costs in Norwegian milk and grain production by the same principles as IFCN (1998). These calculations are based on a farm with 13 dairy cows in western Norway (representing the average herd size in Norway), and a farm in the fertile southwestern region of Jæren with 29 dairy cows, representing a rather large family farm by Norwegian standards.

The difference between costs in Norway and New Zealand/Australia is due to several factors, such as climate, farm size and structure, agricultural policy, wage level, etc. We wish to take a closer look at the effect of climate on production costs.

4.2.1 Norwegian milk production in an international perspective

According to NILF's previous calculations, production costs (break even) for the smaller farm in western Norway were NOK 8.06 per kg milk, compared to NOK 5.51 per kg milk for the 29-cow farm in Jæren. In Table 4.2 the production costs for dairy farms in the USA, Australia, New Zealand and France are shown as US Dollars per 100 kg milk. The data represent "typical" farms more than average figures. The average milk yields per cow in New Zealand and Australia in 1998 were 3,400 litres (New Zealand Dairy Board 1999) and 4,744 litres (Australian Dairy Corporation 1999), respectively. The average milk yield in Norway in the same year was 5,796 litres (Budsjettnemnda for jordbruket 1999a).

Table 4.2 Production data in dairy farming

	Production costs (US$/100 kg milk)	Herd size (no. cows)	Delivered to dairy (tons /cow)	Farm size (ha)	ha/cow
Australia	19	150–250	5.3–5.7	106–183	0.7
France	40–50	30–75	7.5–8.1	39–116	1.3–1.5
New Zealand	17	225–482	4.0–4.1	103–244	0.5
Norway	78–114	13–29	5.7–5.9	14–25	0.9–1.1
USA	25–30	70–600	8.4–8.7	79–405	0.7–1.1

Source: IFCN (1998) and NILF (1999).

Norway stands out by having the highest production costs (Table 4.2). With regard to dairy delivery and acreage per cow Norway shows little or no difference from the others, but the average herd size is significantly smaller, see also Table 3.8. New Zealand has the lowest production costs at 17 US$/100 kg milk, slightly lower than Australia. In France costs are significantly higher, 40–50 US$/100 kg milk. Other western European countries such as Germany and the Netherlands have about the same level of costs (IFCN 1998).

Table 4.3 shows the allocation of costs on the two Norwegian farms. The results are based on "Account Statistics in Agriculture and Forestry" (NILF 1998a). For the calculation of the opportunity costs of family income, farmland and capital, we applied standard wages for farm workers, regional farmland rental rates and interest rates of 3 % (net capital) and 6 % (loan capital), respectively. The figures in Table 4.3 are not directly comparable those in Table 4.2, which do not include income from by-products such as beef production. Table 4.3 includes the costs of such secondary productions.

Table 4.3 Cost allocation on two Norwegian dairy farms

	Jæren 29 cows			Western Norway 13 cows		
	1000 NOK	NOK/kg	%	1000 NOK	NOK/kg	%
Cash costs						
Registered costs, of which:	624	3.53	51.1	356	4.60	49.1
purchased feed	222			122		
hired labour	79			71		
fertilizers/lime	46			23		
farm buildings	43			17		
Depreciation						
Depreciations	96	0.54	7.9	71	0.92	9.8
Opportunity costs						
Labour	351	1.98	28.7	243	3.14	33.5
Farmland	83	0.47	6.8	22	0.29	3.0
Net capital	21	0.12	1.7	18	0.23	2.5
Loan capital	47	0.27	3.9	14	0.19	2.0
Total costs per kg milk		6.90	100.0		9.37	100.0
US $ per 100 kg milk		**98**			**132**	

It can be seen from the table that the registered costs account for one half of the total costs. The major expenditure item of the registered costs is feed concentrates. The opportunity cost of family labour amounts to about one third of the total costs. Hired labour costs are included in the registered costs.

4.2.2 The influence of climate on production costs

In New Zealand and Australia, grazing is possible throughout the entire year due to the mild climate. Clover-rich pastures enable dairy farmers to achieve annual milk yields of 4000 kg without using large amounts of feed concentrates. Livestock buildings can be kept simple, and costs for feed storage are minimal. However, there are costs in connection with modern milk parlours and fencing. In the following we shall take a look at the extra costs in Norway due to feeding, labour, machinery and buildings.

4.2.2.1 Variable Feed Costs

The calculation is based on an estimate for milk production in NILF's "Handbook for Farm Management 1998/99" (NILF 1998b). The estimated feed requirement is based on an annual milk yield of 6200 kg per cow, whereas the dairy delivery is 6000 kg (Table 4.4).

Table 4.4 Feed requirement given a milk yield of 6200 kg/year

		FUm[5]
Maintenance ration	365 days à 4.7 FUm/day	1719
Production ration	6200 kg à 0.455 FUm/kg	2821
Fetal growth	62 days à 2.1 FUm/day	130
Heifer rearing	0,35 heifers à 2800 FUm	980
Total feed requirement		5650

In this standard calculation the production ration requirement is influenced by changes in milk yields. Lower yields require smaller production rations. However, feed requirements for maintenance, fetal growth and heifer rearing are not influenced by changes in milk yields. A feeding plan based on an annual milk yield of 6200 kg per cow is shown in Table 4.5. Refer to Table 4.7 for the calculation of cost per roughage feed unit.

Table 4.5 Feeding plan based on an annual milk yield of 6200 kg per cow

		Jæren		Western Norway	
Feed type	FUm	NOK/FUm	NOK	NOK/FUm	NOK
Silage/pasture	3500	0.38	1330	0.55	1925
Ruminant feed 97L	2000	2.78	5560	2.78	5560
Ruminant feed 200	150	4.82	723	4.82	723
Sum	5650	1.35	7613	1.45	8208

With an annual milk yield of 6200 kg per cow, the average feed costs for Jæren and western Norway are NOK 1.23 and 1.32 per kg produced milk, respectively. Based on a dairy delivery of 6000 kg, the average costs are NOK 1.27 and 1.37 per kg milk, respectively (Table 4.6). This is equivalent to 18 and 19 US$ per 100 kg milk (see Table 4.2).

Table 4.6 Costs at an annual milk yield of 6200 kg per cow

	Jæren	Western Norway
NOK/kg milk sold	1.27	1.37
US$/100 kg	18	19
NOK/kg milk sold[1)]	0.76	0.86
US$/100 kg[1)]	11	12

1) Based on a feed concentrate price of 1.50 NOK/FUm.

The high feed concentrate price is a main reason for the high cost per feed unit in Norway. Assuming a feed concentrate price at the EU level, i.e. about NOK 1.50/FUm, results in a total feed concentrate cost of 3225 NOK per cow. The costs per kg delivered milk thus decrease to 0.76 and 0.86 for the farms in Jæren and western Norway, respectively.

Our estimates of roughage costs are based on information from Husdyrkontrollen (cow testing assoc., 1998), yield averages from NILF (1999) and calculations by the experimental society in Jæren (Planteforsk 1995). In Norway, pasture use has declined

[5] FUm = Feed Unit milk

from representing 35 percent of the total feed intake in 1959 to 16 percent in 1997 (Husdyrkontrollen 1998). Possible explanations for this development include inadequate field size, poor soils (bogs and marshes) and poor yields. The latter is closely related to the lack of sufficient pasture crops in Norway. Perennial rye grass, the most commonly used pasture crop in other countries, is not very winter hardy and can only be grown in the mildest parts of the country.

Studies carried out in Jæren (south-western Norway) show that it is profitable to use arable land for grazing, provided the farmer is good at pasture management (Planteforsk 1995). In Jæren, the variable costs for pasture use and silage in 1994 were 0.20 and 0.38 NOK/FUm, respectively. Yields were relatively high, 7000 and 7500 FUm per ha for pasture and silage, respectively, and the yield difference was less than the 25–50 percent mentioned by Planteforsk (1995). Our estimates are based on the assumptions presented in Table 4.7. The table presents the forage production costs in Jæren and western Norway. Costs are higher in western Norway due to lower yields. Yields are assumed to be 10 and 35 percent lower for grazing than for silage in Jæren and western Norway, respectively.

Table 4.7 Yields and costs in forage production

	Share of feed requirement (%)	FUm/ha	NOK/ha	NOK/FUm
Jæren				
Silage	35	6000	2880	0.48
Fresh grass	6	8000	1880	0.24
Pasture	21	5400	1380	0.26
Sum	62			0.38
Western Norway				
Silage	40	4150	2580	0.62
Fresh grass	2	4000	1580	0.40
Pasture	16	2700	1080	0.40
Sum	58			0.55

Since year-round grazing isn't possible in Norway, feed costs are higher than in New Zealand. The cost differences will be analysed in the following.

The feed costs estimations are based on two different assumptions. In one scenario, we have reduced the annual milk yield to 4000 kg per cow, the other is based on the present yield level.

An annual milk yield of 4000 kg per cow would reduce the feed requirement per cow by 1064 FUm to 4589 FUm, relative to present yields (Table 4.8). We assumed that this feed requirement is completely covered by grazing, even though supplementary feed (silage) is given in New Zealand in dry periods (Samvirke 1999:34–35).

Table 4.8 Feed requirement given a milk yield of 4000 kg/year

	FUm
Maintenance ration	1719

Production ration 4000 kg à 0.44 FUm/kg	1760
Fetal growth	130
Heifer rearing	980
Sum	4589

Only the production ration allowance has been changed from the more "traditional" Norwegian feeding plan. An annual milk yield of 4000 kg per cow amounts to an average daily yield of 13.3 kg per cow for a 300 day lactation period. Even though yields are not constant throughout the lactation period, it is realistic that such yields can be achieved without the use of feed concentrates. Grazing trials from Jæren in the summer of 1999 showed that cows milked an average of 24 litres per day without access to concentrates. The highest daily yield among those cows that did not receive concentrates was 38.5 litres (Norsk Landbruk 1999).

Some key figures for dairy production in Jæren and western Norway are presented in Table 4.9. Assumed feed concentrate price is NOK 1.50 per FUm. The table also shows the influence of a short grazing season on the direct feed costs.

Table 4.9 Feed costs for two grazing scenarios and different milk yield levels

	Jæren		Western Norway	
	Present situation	Year-round grazing period	Present situation	Year-round grazing period
Milk sold, kg/cow	6000	3871	6000	3871
Feed requirement, FUm	5650	4589	5650	4589
Feed costs per cow, NOK	4555	918	5150	918
Costs per kg milk, NOK	0.76	0.22	0.86	0.22
Costs per kg milk, US$/100 kg	10.7	3.1	12.2	3.1

However, such comparisons as in Table 4.9 should be regarded with caution, due to a number of other factors. Milk quota schemes and farm infrastructure are important cost-determining factors. For example, a milk yield of 3871 kg/cow would necessitate larger dairy herds in order to fulfil the milk quota. Larger herds would lead to increased labour costs, whereas building costs would decrease. However, lower per cow milk yields, increased herd sizes and extended grazing would require more area. This is, however, difficult to achieve in many parts of Norway due to natural limitations, especially in the western part of the country.

We have therefore chosen to maintain the present yield level in the calculations, but have assumed that harvested roughage is substituted by grazing, and have maintained 1061 FUm feed concentrates. The results of this calculation are presented in Table 4.10.

Table 4.10 Feed costs for two grazing scenarios, based on an annual milk yield of 6200 kg per cow

	Jæren		Western Norway	
	Present situation	Year-round grazing period	Present situation	Year-round grazing period
Milk sold, kg/cow	6000	6000	6000	6000
Feed requirement, FUm	5650	5650	5650	5650
Feed concentrates, FUm/cow	2150	1061	2150	1061
Costs per kg milk, NOK	0.76	0.42	0.86	0.42
Costs per kg milk, US$/100 kg	10.7	5.9	12.2	5.9

An extension of the grazing period thus leads to a cost reduction per kg milk of 0.34 and 0.44 NOK in Jæren and western Norway, respectively (Table 4.10).

4.2.2.2 Labour costs in forage production

Two alternatives for the reduction of feed costs have just been presented. Substituting feed concentrates and harvested roughage with extended grazing will alter labour input and labour costs. In table 4.3 it was shown that labour costs account for a significant share of the total costs, actually as much as 28.7 percent for the 29-cow dairy farm in Jæren.

Harvesting winter feed requires more labour than grazing. There is, of course, the need for setting up and moving fences and gathering the animals for milking. In the calculations, this labour input in connection with grazing is assumed to be about the same as the labour input necessary for indoor feeding. In the scenario with extended grazing and lower milk yields, we assumed a feed requirement of 4586 FUm, whereas the "traditional" scenario (high milk yields per cow) had a roughage requirement of 3500 FUm. In the calculation, we use the ratio between the number of grazing days and the number of indoor feeding days as a key for the distribution of winter feed and pasture forage. In Jæren (south-western Norway), we assume a grazing period for dairy cows of 148 days, and 123 days in western Norway. Harvested fodder is fed for the remainder of the year. This should correspond to 2081 FUm (3500 FUm*217/365) in Jæren and 2321 FUm in western Norway. With forage yields of 6000 and 4150 FUm per ha, respectively, the required acreage needed to secure winter feed in Jæren and western Norway is 0.35 and 0.56 ha per cow, respectively. Table 4.11 presents the necessary labour input in connection with forage harvesting.

Table 4.11 Labour input in forage production (Hours per ha)

	Jæren	Western Norway
Silo preparation, maintenance, etc.	1.9	1.9
Harvesting[1)]	20.0	15.0
Sum	21.9	16.9

1) 3 cuts in Jæren, 2 cuts in Western Norway

An acreage requirement of 0.35 ha per cow results in a labour input of 7.6 hours per cow in Jæren, and 9.45 hours per cow on the western Norwegian farm. Assuming labour costs in 1998 of NOK 114.22 and 110.72 per hour for Jæren and Western Norway[6] (Landbrukets Arbeidsgiverforening et al. 1998) gives a cost per cow of NOK 868 and 1046, respectively. Expressed per kg sold milk, the costs are NOK 0.14 per kg (NOK 868/6000 kg) on the farm in Jæren, and NOK 0.17 per kg (NOK 1046/6000 kg) on the western Norwegian farm.

4.2.2.3 Machinery and equipment costs

Year-round grazing makes several machines superfluous, since the need for harvesting bulk fodder is eliminated or reduced to a minimum. Some machinery is still necessary for pasture regeneration and transport. The equipment that is not needed in a situation of year-round grazing is presented in table 4.12 and 4.13. However, equipment such as a tractor, plough, harrow, seeder and fertilizer spreader is still necessary.

In the calculation of the capital costs we used the annuity method. The rate of interest is 4.5 percent, and annual maintenance is estimated at 5 percent of half of the depreciated value. Prices for fertilizer handling and feeding equipment are according to Gjerde (1996), and the other prices are from the Budget Committee for Agriculture (Budsjettnemnda for jordbruket 1999b).

Table 4.12 Machinery costs for the production of winter feed in Jæren

	Price (NOK)	Service life (years)	Cost of capital (NOK)	Maintenance	Sum
Tractor nr. 2, 42 kwh	224592	16	19992	5615	25607
Forage harvester 1.5 m	53077	10	6708	1327	8035
Trailer	31218	20	2400	780	3180
Hayloader 2 x	147770	13	15261	3694	18955
Front loader	40972	15	3815	1024	4839
Fertilizer handling equipment	199358	11	23374	4984	28358
Bulk fodder handling	158759	20	12205	3969	16174
Feed dispenser	113581	15	10576	2840	13416
Sum					118564

The annual costs for the machinery necessary for growing (and feeding) winter fodder in Jæren are estimated at NOK 118,564 (Table 4.12). The costs per kg sold milk are thus NOK 0.68.

[6] In the calculations we applied standard wages + 3.7% for movable public holidays + 10.2% vacation allowance + payroll tax.

Table 4.13 Machinery costs for the production of winter feed in western Norway

	Price (NOK)	Service life (years)	Cost of capital	Maintenance	Sum
Tractor nr. 2, 35 kwh ½	96243	25	6491	2406	8897
Forage harvester 1.3 m	48688	13	5028	1217	6245
Trailer	39410	20	3030	985	4015
Hayloader	48815	15	4545	1220	5766
Front loader ½	18853	17	1610	471	2082
Fertilizer handling equipment	149385	11	17515	3735	21250
Bulk fodder handling	101158	20	7777	2529	10306
Sum					58560

For the somewhat smaller farm in western Norway the annual machinery costs are estimated at NOK 58,560 NOK (Table 4.13), which is equivalent to NOK 0.80 per kg sold milk.

4.2.2.4 Building costs

Building costs in Norway are significantly higher than in most other countries. This is mainly due to the harsh climate, but also to the high level of costs in general. Furthermore, the farm structure, with small farms and small herds, leads to high building costs per head of livestock. Herd size is, however, not only influenced by natural conditions, but also by political, economical and cultural factors. During the past years there has been some focus and research on finding innovative and less costly constructions for dairy production. In spite of this, there have been no changes that have led to significantly lower costs per cow[7].

In the following we shall estimate the additional costs of the Norwegian building standards compared to the building standards in New Zealand/Australia. The estimates apply to herd sizes of 12 and 29 cows. The allocation of building costs on which the cost estimate for the 29-cow farm is based is shown in Table 4.14 (Gjerde 1996).

[7] In 1996, the Dept. of Agricultural Engineering at the Agricultural University of Norway estimated the costs for various construction alternatives in dairy farming, and concluded that non-insulated buildings give lower building costs than insulated ones, but machinery and labour costs are higher. All in all, little can be saved by building without insulation (Gjerde 1996).

Table 4.14 Specification of building costs (in NOK 1000 and percent)

	21 cubicles insulated	44 cubicles insulated	29 cow estimate	%
Manure storage	446	724	555	18.7
Livestock housing	946	1805	1282	43.3
Additional space	240	236	238	8.1
Feed storage	747	1103	886	29.9
SUM	2379	3868	2962	100.0

The prices in the table are 1994 prices, but we are mostly interested in the relative cost distribution. For the estimation of building costs per kg milk, it is roughly assumed that costs in Australia/New Zealand are about 20 percent of the costs in Norway. This assumption is based on the following reasoning: Manure storage facilities are not needed since the animals graze year-round. Silos and other bulk fodder storage facilities are also not required. Some additional space is still needed, e.g. a milk-handling room, but the livestock housing facilities can be built much simpler, since insulation and space for cubicles are not necessary.

For the 12-cow farm, the allocation of building costs is about the same as for the 29-cow farm in the table above. Costs for livestock housing and additional space are a few percent lower on the smaller farm, but we didn't change the estimate of 20 percent that was used for the 29-cow farm.

In Table 4.15, the costs per kg milk are shown, based on the Norwegian building standards (Gjerde 1998). For herds of 29 cows we have estimated a cost of NOK 1.37 per kg milk, assuming an annual milk yield of 6200 kg per cow. Annual depreciations (30 years) and interest (4.5%) are estimated by the annuity method, whereas maintenance costs are fixed at 3 percent of half of the depreciated value.

Table 4.15 Capital and maintenance costs for farm buildings in dairy production

Herd size	Investm. costs, NOK per cow	Depreciat. and interest, NOK	Maintenance, NOK	NOK/kg milk	20 % of the Norwegian level of costs	
					NOK/kg milk	difference
12	139800	8583	2097	1.78	0.36	1.42
22	119700	7349	1796	1.47	0.29	1.18
29	111100	6821	1667	**1.37**	**0.27**	**1.10**
46	93900	5765	1409	1.16	0.23	0.93
66	88600	5439	1329	1.09	0.22	0.87
132	79700	4893	1196	0.98	0.20	0.79

The table shows that the additional costs in Norway, partially due to climate, are NOK 1.10 per kg milk on a farm with 29 cows. Costs on a western Norwegian dairy farm, with 12 cows, are NOK 0.41 per kg milk higher. For such small farms, building costs are lower for conventional cowsheds, and thus the cost estimate for this farm type is based on such buildings.

4.2.2.5 Summary and Discussion

Table 4.16 presents the allocation of costs in dairy farming in Norway for two different scenarios: the present situation and with year-round grazing. In both scenarios, the price of concentrates is reduced to the EU level.

Table 4.16 Cost differences between two scenarios, NOK per kg milk

	Jæren		Western Norway	
	Present situation	Year-round grazing	Present situation	Year-round grazing
Feed costs	0.76	– 0.34	0.86	– 0.44
Labour input, forage production	0.14	– 0.14	0.17	– 0.17
Building costs	1.37	– 1.10	1.78	– 1.42
Machinery costs	0.98	– 0.68	1.35	– 0.80
Sum, NOK/kg milk	3.25	– 2.26	4.16	– 2.83
US $/100 kg	46	–32	60	–41

Comparing Norway and New Zealand, one could say that the short growing season in Norway leads to additional costs of NOK 2.26 and 2.83 per kg milk in Jæren and western Norway respectively. Building and machinery costs are reduced the most in the (hypothetical) transition from present Norwegian farming practice to a year-round grazing scheme. Lower costs due to the approximately 35 percent lower farm worker wages in New Zealand have not been included in the calculations.

As earlier mentioned, labour costs (i.e., opportunity costs of the farmer's own labour input) account for about 30 percent of the total production costs in Norwegian dairy production. This can be related to both the high wage level in general and to the relatively small herds in dairy farming. On the western Norwegian farm (12 cows), labour costs are NOK 4.11 per kg milk (58 USD/100 kg milk), and on the 29-cow farm in Jæren labour costs are NOK 2.24 per kg milk (32 USD/100 kg milk). The additional costs caused by smaller herd size are thus NOK 1.87 per kg milk. Assuming the same standard wages as in New Zealand (NOK 55 per hour), production costs would be NOK 2.04 per kg milk for the western Norwegian farm and NOK 1.08 per kg milk for the farm in Jæren. The cost reduction due to lower wages would thus be NOK 2.07 and 1.16 per kg milk for the two farms respectively.

In comparison, labour costs in New Zealand/Australia amount to NOK 0.26 to 0.28 per kg milk, with herds of between 150 and 480 cows. The low costs are thus a result of both a low level of wages and large herds.

Referring to table 4.15, it can be seen that building costs were reduced from NOK 1.78 per kg milk on a 12-cow farm to NOK 0.98 per kg milk on a 132-cow farm. We haven't estimated the machinery costs for a 132-cow farm in Norway, but scale advantages are less for machinery than for buildings.

4.3 Costs in sheep farming

4.3.1 The influence of climate on production costs

Climate also influences production costs in sheep farming. We shall therefore present a cost estimation for sheep farming, using the same method as for dairy farming. The calculations are only carried out for western Norway.

4.3.1.1 Variable feed costs

The variable feed costs per kg sheepmeat vary considerably, depending on the use of rough grazing land. Climate and access to grazing land determine how much of the feed requirement can be covered from rough grazing, and how much by harvested bulk fodder. A more favourable climate implies a longer rough grazing period, and that sheep could graze on infields instead of harvesting winter feed there. The result would be lower variable costs. A feed cost estimate is presented in Table 4.17, based on present prices, with the exception of the concentrate price (EU price level). The prices per feed unit for harvested bulk fodder and infield pasture are the same as in the dairy production estimates.

Table 4.17 Feed cost estimate for 1 winter-fed sheep, present situation in Norway

Feed type	NOK/FUm	FUm	NOK
Harvested bulk fodder	0.62	180	111.6
Infield pasture	0.40	85	34
Feed concentrates	1.50	50	75
Sum Fum		315	220.6

Based on Model Farm Calculations (Budsjettnemnda for jordbruket 1999b), we have assumed a yield of 25.4 kg meat per winter-fed sheep (wfs.). The variable feed costs thus amount to NOK 8.69 per kg meat.

A revised feed cost estimate, based on year-round grazing, is presented in Table 4.18. Compared to the previous estimate, the rough grazing season is extended, infields are only used for grazing, and concentrates are omitted from the feeding plan.

Table 4.18 Feed cost estimate for 1 winter-fed sheep, more favourable climate

Feed type	NOK/FUm	FUm	NOK
Infield pasture	0.4	240	96
Feed concentrates	1.5	0	0
Sum Fum		240	96

Compared to the estimate in Table 4.17, the feed requirement is reduced from 315 FUm to 240 FUm. Since rough and infield grazing are the only sources of feed, the variable feed costs are reduced to NOK 3.78 per kg meat. In addition, the necessary acreage per sheep is reduced by 0.01 ha to 0.09 ha.

4.3.1.2 Labour costs in forage production

Labour costs in forage production are reduced since there no longer is the need for harvesting winter feed. Infield grazing substitutes 180 FUm silage/hay, which corresponds to 0.04 ha (180 FUm/4150 FUm/ha).

An acreage requirement of 0.04 ha requires a labour input of 0.73 hours per wfs. Assuming a standard wage of NOK 110.72 per hour (1998), the cost reduction would be NOK 80 per wfs., or NOK 3.15 per kg meat.

4.3.1.3 Machinery costs

Based on machinery and equipment data from the Model Farm Calculations (NILF 1999b), we have estimated the machinery costs per kg sheepmeat at NOK 10.77. Assuming a transition to year-round grazing, a number of machines become superfluous, these are presented in Table 4.19. Machinery needed for a year-round grazing strategy, such as tractors and equipment for pasture regeneration, are kept.

Table 4.19 Equipment (and costs) unnecessary on sheep farms with year-round grazing

Equipment	Price NOK	Service life (years)	Interest and depreciation NOK	Maintenance NOK	Sum NOK
Rotory mower	10987	15	1023	275	1298
Haytedder	5831	15	543	146	689
Hay sweep	7428	20	571	186	757
Forage harvester 1.1 m	39882	15	3714	997	4711
Trailer	28105	18	2311	703	3014
Sum					10468

By excluding the equipment used in bulk fodder harvesting, the costs per kg meat are reduced by NOK 3.12 to NOK 7.65 (Table 4.21). The largest single item is the tractor, amounting to a cost of NOK 5.41 NOK per kg meat.

4.3.1.4 Building costs

In estimating building costs, we assume an even greater reduction in the (hypothetical) transition from traditional Norwegian sheep husbandry to year-round grazing than in the dairy farm calculations. Since sheep housing has much simpler building standards, we assume the building costs to lie at approximately 10 percent of the present Norwegian level of costs.

Table 4.20 Capital and maintenance costs for sheep barns.

Number of sheep	Investment costs NOK/sheep	Depreciation yrs.	Deprec. and interest NOK	Maintenance 3 %	NOK/kg sheepmeat	10 % of the Norwegian cost level, NOK/kg
50	10900	30	669	164	32.78	3.28
100	8400	30	516	126	25.26	2.53
132	8144	30	500	122	**24.49**	**2.45**
200	7600	30	467	114	22.86	2.29
400	6500	30	399	98	19.55	1.95

4.3.1.5 Summary and discussion

Table 4.21 shows the cost allocation for two different scenarios, traditional Norwegian sheep farming and year-round grazing.

Table 4.21 Cost allocation and difference between two sheep farming scenarios, NOK per kg sheepmeat

	Western Norway		
	Present situation	Year-round grazing	Difference
Feed costs	8.69	3.78	–4.91
Labour input, forage production	3.15	0	–3.15
Building costs	24.49	2.45	–22.04
Machinery costs	10.77	7.65	–3.12
Sum, NOK/kg meat	47.10	13.88	–33.22
US $/100 kg meat	666	196	–470

The table shows that year-round grazing would reduce the total costs by NOK 33.22 per kg sheepmeat on a farm with 132 wfs. in western Norway. The lion's share of these reductions are building costs (NOK 22.04 per kg), followed by feed costs (NOK 4.91 per kg).

Costs for labour on the sheep farm are NOK 82.40 per kg meat (1165 USD/100 kg meat). With standard wages corresponding to those in New Zealand (NOK 55 per hour), labour costs would have been NOK 40.90 per kg meat. Lower wages would thus further reduce costs by NOK 41.50 per kg meat.

In table 4.20 it was shown that building costs were NOK 24.49 per kg meat on a farm with 132 wfs., and NOK 19.55 per kg meat on a farm with 400 sheep. We have not estimated the reduction of machinery costs due to the economy of scale, but it would presumably be less than for the building costs.

5 Summary

This report was written in connection with the preparations of the Norwegian authorities for the new round of WTO negotiations on further liberalization of world trade.

The report surveys the natural conditions in Australia, France, New Zealand, Norway and the USA, and studies their influence on agriculture, e.g., on farm size, farmland distribution, types of production and production costs. However, it is not easy to limit the analysis to merely the natural conditions for farming, since a number of other political, legal, economic, historic and cultural factors also determine the conditions for agriculture in a country.

The report includes agroclimatic data such as length of growing-season, temperature sums, mean temperatures and mean precipitation. Not surprisingly, the climate in Australia and New Zealand is significantly different from the climate in Norway. In these two countries, low temperatures are not a major growth-limiting factor, as they are in (parts of) France, Norway and the USA. Especially in Australia, growth is mainly limited by too high temperatures, excessive radiation, evaporation and lack of rainfall.

The growing season is defined as the number of days per year with a mean temperature above 5 ^{o}C. The temperature sum is the sum of the daily differences between a minimum threshold temperature (5 ^{o}C) and the daily mean temperature. Length of growing season and temperature sum are good indicators for the growth potential in areas in which temperature is a minimum factor. Therefore, these parameters are not suitable as measures for the growth potential in Australia and New Zealand. We have nevertheless chosen to present temperature sums for all countries, since they illustrate the significant climatic differences between them.

Climate data is presented from a number of scattered weather stations in each country, chosen to represent various types of farming areas. The figures are meant to illustrate climatic differences between countries, but do not give a complete picture of climatic variations.

A closer look is taken at climate data for some selected wheat-growing areas. France has the longest wheat-growing season. The length of the growing season in the Paris region is 281 days, and starts about one month earlier than in Norway (Ås, 235 day growing season) and in midwestern USA (210–230 days).

The Paris region has an annual temperature sum of 2140 degree days, in the Midwest (USA) it varies between 1858 (Montana), 2390 (South Dakota) and 2799 degree days (Nebraska). In south-eastern Norway (Ås) the annual temperature sum is 1327 degree days. The monthly distribution of mean daily temperatures and temperature sums shows that France has an overall milder climate, with less variations throughout the year than midwestern USA and Norway.

In Australia, many places have about the same temperature sums during winter as in Norway during summertime. New Zealand also has high temperature sums in wintertime. The data on mean daily temperatures underlines the climatic differences between Australia and New Zealand on one hand, and France, Norway and the USA on the other.

The mild climate in Australia and New Zealand not only creates good conditions for crop production, but also allows year-round grazing. The short grazing season in Norway is due to low temperatures, snow cover and excessive rainfall in parts of the country. Initially, the length of the grazing period is limited by the length of the growing season. However, the grazing period in many parts of the country is further shortened by high rainfall, which in turn can lead to water-logged soils with poor carrying capacity.
Harsh winters with frost and snow cover limit crop and livestock production, but also warm climates can have adverse effects on crop production by creating good conditions for plant diseases and pests. A cold climate furthermore influences the operation, maintenance and heating of farm buildings, storage facilities, etc. In contrast to Norway and parts of the USA, the selected farming regions in France, Australia and New Zealand have no months with average temperatures below 0^{o}C.

Plant growth is inhibited by the lack of rainfall. Of the countries surveyed, Australia is especially vulnerable in this respect. However, there can be large variations within a country. Only data over the total amount of precipitation per month is presented, whereas also rainfall frequency, intensity and duration are important.

It was difficult to obtain comparable data on slope gradients and land consolidation. However, the topographical differences between the countries at a national level are presented as topographical maps.

The extent and distribution of farmland and agricultural production is also a result of natural conditions. The relative share of agricultural land of a country's total land area reflects, *inter alia*, topography, soil quality, climate, etc. In Australia, New Zealand and France agricultural land use dominates, covering 60, 56 and 55 percent of the total land area respectively. In the USA, about 46 percent of the total area is farmland, and in Norway only 3 percent.

In the European Union, the percentage of cereal acreage of a country's total agricultural acreage is used as an indication of the farming conditions in a given area (climate, soil, etc.). In Norway, cereals[8] account for 37 percent of the arable land and permanent crops, compared to 47 percent in France, 35 percent in the USA, 32 percent in Australia and 5 percent in New Zealand. In Norway, the percentage of wheat of the total acreage of temperate cereals[9] is lower (23 percent) than in France, USA and Australia, where wheat is grown an about ¾ of the temperate cereal acreage.

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[8] Cereals include wheat, barley, rye, oats, millet, sorghum, buckwheat, triticale, canary seed, mixed grain, rice (paddy), maize and cereals nes.
[9] Cereals excl. maize and rice (paddy).

Natural conditions such as topography, geology, soil quality, etc. also play a major role in determining farm size variations. Australia has the largest average farm size (3800 ha), more than 347 times larger than an average Norwegian farm. In the early 1990's the average farm size in New Zealand, the USA, France and Norway was 224, 194, 35 and 11 ha respectively. At present, average farm size in Norway is 13 ha. More than 80 percent of the Norwegian farms are smaller than 20 ha. In France and the USA, less than 50 percent and 30 percent, respectively, of the farms are smaller than 20 ha. Most farms in Norway are between 5 and 20 ha. In France, farm sizes are more evenly distributed. In Australia, less than 20 percent of the farms are smaller than 50 ha, most are 100–500 ha, and about 30 percent are evenly distributed between 500 and 5000 ha large farms. In the USA, there is also a significant share of large farms.

The number of livestock (cattle, sheep and dairy cows) per farm is much smaller in Norway than in the other countries. Herds in France are still much smaller than in Australia, New Zealand and the USA. Australia has the largest number of cattle per farm, while New Zealand has most dairy cows and sheep per farm.

Agricultural labour input reflects the degree of rationalization, which again is connected to farm infrastructure (farm size and distribution). The labour input per 100 ha farmland in operation is 8.7 man-years in Norway and 3.5 man-years in France.

The cost of agricultural labour is not directly comparable, but the presented data nevertheless gives an impression of wage differences. Norway clearly has the highest wages, at NOK 86 per hour, followed by France and New Zealand with approximately NOK 57 and the USA with NOK 54 per hour.

Norway's short growing season and cold winters result in additional production costs in agriculture. In addition, the very small-scaled structure of Norwegian agriculture leads to extremely high production costs compared to countries with better natural conditions and larger operating units.

In this report, the production costs related to the short growing season in Norway have been estimated for dairy production and sheep farming. A number of costs can be related to climate. One of the major factors are high building costs. For an average dairy farm (13 cows), the total extra costs amount to NOK 2.83 per kg milk, of which NOK 1.42 can be attributed to building costs. Cows are indoors for many months during the winter. This requires additional barn space, as well as storage facilities for feed and manure. Equipment for growing and harvesting winter fodder, feed and manure handling represent an increase of costs of NOK 0.80 per kg milk.. Due to the limited grazing season, costly feed such as concentrates and silage must be used. This additional cost is estimated at NOK 0.44 per kg milk. The additional labour necessary for growing winter fodder is estimated to represent an extra cost of NOK 0.17 per kg milk.

For a dairy farm with 29 cows (large by Norwegian standards) in Norway's best farming district Jæren, the total additional costs are estimated to be slightly lower, NOK 2.26 per kg milk.

The calculations for sheep farms were carried out using the same method as for the dairy farms. The total additional costs for production of lamb and mutton are NOK 33.02 per kg meat. As in dairy farming, building costs represent most of the difference, at NOK 22.04 per kg. Additional feed costs account for extra costs of NOK 4.91 per kg meat.

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Appendix 1

Total export value of agricultural commodities – 1997

	Total agricultural output (1 000 000 $)	Share of total export (%)
World	452 126	
USA	62 544	13.8
France	38 502	8.5
Netherlands	32 058	7.1
Germany	24 584	5.4
Belgium-Luxembourg	18 010	4.0
United Kingdom	17 403	3.8
Australia	16 946	3.7
Brazil	16 427	3.6
Italy	15 735	3.5
Canada	15 192	3.4
New Zealand	7 034	1.6
Norway	536	0.1

Adapted from FAO 1999.

Export value of various agricultural products, and their share of the different countries' (world's) total agricultural export value. 1997 data.

	Beef and Veal (1000$)	Beef and Veal Boneless (1000$)	Goat Meat (1000$)	Mutton and Lamb (1000$)	Total Meat (1000$)	Cereals (1000$)	Agr. products Total (1000$)	Share of meat of the country´s total (%)	Share of cereals of the country´s total (%)	Share of meat of the world's total (%)	Share of cereals of the world's total (%)
World	4 517 716	8 973 607	41 987	2 396 882	44 048 068	41 843 946	452 126 143				
Australia	101 947	1 743 036	16 225	462 728	2 435 787	4 219 037	16 946 169	14.4	24.9	5.5	10.1
France	691 951	388 075	16 061	31 630	4 084 058	4 869 172	38 501 923	10.6	12.6	9.3	11.6
New Zealand	36 518	654 124	4 111	1 046 009	1 875 730	2 722	7 034 316	26.7	0.0	4.3	0.0
Norway	1 053	523	0	1 163	13 117	315	535 724	2.4	0.1	0.0	0.0
USA	269 102	2 171 169	889	6 473	6 337 965	11 534 309	62 544 430	10.1	18.4	14.4	27.6

Adapted from FAO 1999.

Appendix 2

The geographical position of the weather stations and major agricultural products in the region

Country	Weather station	Position	Elevation (m)	Products[10]
Australia				
Queensland	Richmond	20.7°S, 143.1°E	211	Beef and sheep
New South Wales	Hay	34.5°S, 144.9°E	93	Wheat
	Sydney	33.9°S, 151.2°E	6	Dairy
Victoria	Melbourne	37.8°S, 145.0°E	35	Dairy
	Wangeratta	36.3°S, 142.4°E	113	Wheat
Western Australia	Perth	32.0°S, 115.9°E	19	Wheat and dairy
France	Brest	48.3°N, 4.3°W	103	Dairy and wheat
	Paris	48.6°N, 2.3°E	65	Wheat
	Nancy/Essey	48.4°N, 6,1°E	217	Dairy and wheat
	Nantes	47.1°N, 1.4°W	27	Dairy and beef
	Lyon/Bron	45.4°N, 4.6°E	201	Dairy and beef
	Toulouse/Blagnac	43.4°N, 1.2°E	153	Wheat, beef and sheep
Norway	Ås	59.4°N, 10.5°E	95	Cereals (incl. wheat)
	Koppang	61.4°N, 10.6°E	303	Cereals (barley, oats), dairy, beef and sheep
	Tonstad-Nettfed	58.4°N, 6.4°E	55	Dairy, beef and sheep
	Leikanger	61.1°N, 6.5°E	53	Dairy, beef and sheep
	Steinkjær	64.0°N, 11.5°E	35	Cereals (barley)
	Bodø	67.2°N, 14.2°E	11	Dairy, beef and sheep
	Kautokeino	69.0°N, 23.0°E	306	Dairy, beef and sheep

[10] Products from among the selected agr. products cereals (wheat), dairy, beef and sheep.

New Zealand				
North Island	Hamilton	..	40	Dairy, beef and sheep
	New Playmouth	39.0°S, 174.2°E	27	Dairy
	Gisborne	38.7°S, 178.0°E	4	Beef and sheep
	Napier	..	2	Beef and sheep
South Island				
	Christchurch	43.5°S, 172.6°E	7	Wheat, sheep and beef
	Timaru	..	25	Wheat, sheep and beef
USA				
West	Sacramento (California)	35.2°N, 121.3°W	21	Dairy, beef and sheep
	Glasgow (Montana)	48.1°N, 106.4°W	696	Wheat, beef and sheep
	Huron (South Dakota)	44.2°N, 98.1°W	391	Wheat, beef and sheep
Midwest	Grand Island (Nebraska)	40.6°N, 98.2°W	565	Wheat and beef
	Minneapolis (Minnesota)	44.5°N, 93.1°W	254	Dairy and beef
	Peoria (Illinois)	40.4°N, 89.4°W	199	Dairy
South	Dallas (Texas)	32.5°N, 97.0°W	175	Beef, dairy and sheep
Northeast	Harrisburg (Pennsylvania)	40.1°N, 76.5°W	104	Dairy

Appendix 3

Mean daily temperature (^oC)

Country	Weather station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Australia														
Queensland	Richmond	30.0	29.0	27.8	24.8	21.1	18.0	17.3	19.3	22.9	26.8	29.1	0.2	24.7
New South Wales	Hay	24.7	24.4	21.5	17.0	13.0	10.1	9.3	10.9	13.6	17.0	20.4	23.0	17.1
	Sydney	22.4	22.5	21.2	18.3	15.3	12.9	11.9	13.0	15.1	17.6	19.5	21.4	17.6
Victoria	Melbourne	20.0	20.0	18.4	15.5	12.6	10.4	9.6	10.7	12.5	14.5	16.4	18.5	14.9
	Wangeratta	22.0	22.3	19.6	15.6	12.2	9.4	8.8	10.1	11.6	14.6	17.5	20.2	15.3
Western Australia	Perth	23.8	24.0	22.4	19.5	16.3	14.2	13.2	13.6	14.9	16.5	19.3	21.8	18.3
France	Brest	6.1	6.1	7.4	7.8	10.8	11.8	16.0	16.0	14.7	12.2	8.9	7.3	10.4
	Paris	3.3	4.0	6.6	9.6	13.3	16.4	18.2	17.8	15.3	11.1	6.6	4.3	10.5
	Nancy/Essey	1.3	2.2	5.2	7.3	10.9	13.5	18.1	17.5	14.4	9.9	4.9	2.1	9.0
	Nantes	5.0	5.7	7.9	8.8	12.5	13.3	19.0	18.4	16.4	12.7	8.3	5.9	11.2
	Lyon/Bron	2.4	4.0	7.1	10.3	14.4	17.9	20.3	19.5	16.4	11.5	6.4	3.1	11.1
	Toulouse/Blagnac	4.8	5.9	8.5	10.3	14.2	15.9	17.8	20.7	16.9	12.8	7.2	4.2	11.6
New Zealand														
North Island	Hamilton	18.3	18.6	17.1	14.5	11.6	9.4	8.7	9.8	11.5	13.1	15.0	16.9	13.6
	New Playmouth	17.7	17.9	16.9	14.6	12.1	10.2	9.4	10.1	11.5	12.7	14.5	16.2	13.6
	Gisborne	19.2	18.8	17.4	14.8	12.0	9.9	9.3	10.2	11.8	13.8	15.9	17.9	14.3
	Napier	19.4	19.2	17.7	15.0	12.0	9.5	9.2	10.0	12.1	14.2	16.1	18.2	14.4
South Island	Christchurch	17.4	17.1	15.5	12.8	9.5	6.8	6.5	7.7	10.0	12.2	14.2	16.1	12.1
	Timaru	15.8	15.3	14.0	11.3	8.0	5.5	5.2	6.4	8.7	10.5	12.7	14.6	10.8

Norway	Ås	-4.8	-4.8	-0.7	4.1	10.3	14.8	16.1	14.9	10.6	6.2	0.4	-3.4	5.3
	Koppang	-11.6	-9.5	-4.0	1.3	7.9	12.9	14.0	12.4	7.5	2.6	-4.5	-9.4	1.6
	Tonstad-Nettfed	-1.9	-2.1	0.8	4.0	8.8	12.7	14.3	13.5	10.4	6.9	2.3	-1.2	5.7
	Leikanger	-0.8	-0.5	1.6	5.0	10.3	13.8	14.9	14.2	10.3	7.0	2.6	0.3	6.6
	Steinkjær	-5.0	-4.0	-1.0	2.8	8.6	12.8	14.0	13.5	9.4	5.1	-0.5	-3.2	4.4
	Bodø	-2.2	-2.0	-0.6	2.5	7.2	10.4	12.5	12.3	9.0	5.3	1.2	-1.2	4.5
	Kautokeino	-16.1	-15.0	-11.1	-4.4	2.7	9.8	12.4	10.4	4.9	-2.0	-9.3	-14.5	-2.7
USA														
West	Sacramento (California)	7.3	10.4	12.0	14.6	18.5	22.0	24.3	23.9	21.9	17.9	11.8	7.4	16.0
	Glasgow (Montana)	-6.9	-3.1	0.9	6.3	11.4	16.7	20.7	19.7	13.0	7.3	-0.2	-6.0	6.7
Midwest	Huron (South Dakota)	-10.4	-7.0	-0.1	7.9	14.2	19.9	23.6	22.1	16.0	9.2	0.2	-7.7	7.3
	Grand Island (Nebraska)	-5.6	-2.6	3.2	10.4	16.3	21.9	24.8	23.3	17.7	11.3	3.1	-3.7	10.0
	Minneapolis (Minnesota)	-11.2	-7.8	-0.6	8.0	14.7	20.1	23.1	21.4	15.8	9.3	0.7	-7.8	7.1
	Peoria (Illinois)	-5.8	-3.2	3.9	10.8	16.6	21.9	24.2	22.8	18.9	12.2	5.1	-2.8	10.4
South	Dallas (Texas)	6.3	8.8	13.7	18.6	22.7	27.2	29.6	29.4	25.2	19.6	13.4	8.3	18.6
Northeast	Harrisburg (Pennsylvania)	-1.9	-0.4	5.1	10.9	16.6	21.6	24.3	23.4	19.1	12.6	6.9	0.9	11.6

Appendix 4

Mean temperature sum (degree days)

Country	Weather station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Australia														
Queensland	Richmond	773.5	672.0	705.3	594.0	499.1	388.5	379.8	441.8	538.5	675.8	724.5	781.2	7173.8
New South Wales	Hay	609.2	543.2	510.0	358.5	248.0	153.0	131.8	181.4	258.0	370.5	462.0	558.0	4383.4
	Sydney	537.9	488.6	500.7	400.5	317.8	235.5	212.4	246.5	301.5	390.6	435.0	508.4	4575.1
Victoria	Melbourne	463.5	421.4	415.4	313.5	234.1	160.5	141.1	176.7	223.5	294.5	342.0	417.0	3603.0
	Wangeratta	525.5	484.4	452.6	316.5	223.2	132.0	117.8	156.6	199.5	297.6	375.0	471.2	3751.8
Western Australia	Perth	582.8	533.4	539.4	433.5	350.3	276.0	254.2	266.6	297.0	358.0	429.0	522.3	4842.6
France	Brest	34.1	30.8	74.4	84.0	179.8	204.0	341.0	341.0	291.0	223.2	117.0	71.3	1991.6
	Paris	0.0	0.7	49.6	138.0	257.3	342.0	409.2	396.8	309.0	189.1	48.0	0.8	2140.5
	Nancy/Essey	0.0	0.0	17.3	9.0	182.9	255.0	406.1	387.5	282.0	151.9	20.0	0.0	1711.7
	Nantes	2.6	19.6	89.9	114.0	232.5	249.0	434.0	415.4	342.0	238.7	99.0	24.0	2260.7
	Lyon/Bron	0.0	1.6	65.1	159.0	291.4	387.0	474.3	449.5	342.0	201.5	59.3	0.0	2430.7
	Toulouse/Blagnac	1.3	25.2	108.5	159.0	285.2	327.0	396.8	486.7	357.0	241.8	66.0	3.1	2457.6
New Zealand														
North Island	Hamilton	412.3	380.8	375.1	285.0	204.6	132.0	114.7	148.8	195.0	251.1	300.0	368.9	3168.3
	New Playmouth	393.7	361.2	368.9	288.0	220.1	156.0	136.4	158.1	195.0	238.7	285.0	347.2	3148.3
	Gisborne	440.2	386.4	384.4	294.0	217.0	147.0	133.3	161.2	204.0	272.8	327.0	399.9	3367.2
	Napier	446.4	397.6	393.7	300.0	217.0	135.0	130.2	155.0	213.0	285.2	333.0	409.2	3415.3
	Christchurch	384.4	338.8	325.5	234.0	139.5	54.0	46.5	83.7	150.0	223.2	276.0	344.1	2599.7
	Timaru	334.8	288.4	279.0	189.0	93.0	13.0	6.2	43.4	111.0	170.5	231.0	297.6	2056.9
South Island														

Norway	Ås	0.0	0.0	0.0	8.0	164.3	294.0	344.1	306.9	168.0	41.4	0.0	0.0	1326.7
	Koppang	0.0	0.0	0.0	0.0	89.9	237.0	279.0	229.4	75.0	2.3	0.0	0.0	912.6
	Tonstad-Nettfed	0.0	0.0	0.0	4.8	117.8	231.0	288.3	263.5	162.0	66.6	0.0	0.0	1134.0
	Leikanger	0.0	0.0	0.0	19.9	164.3	264.0	306.9	285.2	159.0	62.0	0.0	0.0	1261.3
	Steinkjær	0.0	0.0	0.0	1.6	111.6	234.0	279.0	263.5	132.0	18.2	0.0	0.0	1039.9
	Bodø	0.0	0.0	0.0	0.0	68.5	162.0	232.5	226.3	120.0	19.6	0.0	0.0	828.9
	Kautokeino	0.0	0.0	0.0	0.0	60.1	144.0	229.4	167.4	22.3	0.0	0.0	0.0	623.2
USA														
West	Sacramento (California)	72.3	150.9	217.0	288.3	418.5	510.0	597.6	587.3	508.3	399.6	205.0	74.1	4028.9
	Glasgow (Montana)	0.0	0.0	0.0	57.4	198.1	351.7	485.7	454.7	240.0	70.6	0.0	0.0	1858.2
Midwest	Huron (South Dakota)	0.0	0.0	0.0	89.9	285.9	448.3	575.2	530.4	330.0	129.8	0.0	0.0	2389.5
	Grand Island (Nebraska)	0.0	0.0	8.2	163.3	351.3	508.3	614.8	566.6	381.7	196.3	8.8	0.0	2799.3
	Minneapolis (Minnesota)	0.0	0.0	0.0	102.7	301.4	453.3	561.4	508.1	325.0	134.3	0.0	0.0	2386.2
	Peoria (Illinois)	0.0	0.0	4.4	173.3	359.9	508.3	594.2	552.8	418.3	223.9	20.5	0.0	2855.6
South	Dallas (Texas)	41.3	107.3	270.4	408.3	547.7	666.7	762.9	756.1	606.7	451.2	253.3	101.6	4973.6
Northeast	Harrisburg (Pennsylvania)	0.0	0.0	24.1	176.7	358.2	498.3	597.6	570.1	423.3	235.9	55.2	0.0	2939.4

Appendix 5

Mean amount of precipitation (mm)

Country	Weather station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Australia														
Queensland	Richmond	120.1	104.9	60.7	20.8	16.4	15.0	9.9	4.0	6.5	16.1	29.2	68.7	472.3
New South Wales	Hay	27.2	28.0	29.0	29.0	36.1	36.5	30.5	32.2	31.6	35.5	24.5	26.2	366.3
	Sydney	98.3	112.1	125.2	106.2	97.0	126.2	66.9	77.9	62.6	73.8	82.9	77.1	1106.4
Victoria	Melbourne	49.0	47.7	51.8	58.4	57.2	50.2	48.7	50.6	59.4	67.7	60.2	59.9	660.8
	Wangeratta	..	..	..	..	..	..	..	..	..	..	..	..	..
Western Australia	Perth	8.6	13.3	19.3	45.5	122.7	182.4	172.9	134.6	79.9	54.5	21.7	13.9	869.4
France	Brest	131	108	96	72	75	54	46	59	80	110	120	140	1091
	Paris	50	46	43	36	55	56	51	58	49	47	55	51	597
	Nancy/Essey	60	58	53	51	71	75	59	66	62	59	64	70	748
	Nantes	84	69	65	49	64	45	46	44	62	79	86	84	777
	Lyon/Bron	56	55	63	54	69	81	59	100	82	77	76	59	831
	Toulouse/Blagnac	57	52	57	64	73	57	41	47	47	51	48	55	649
New Zealand	Hamilton	..	..	..	..	..	..	..	..	..	..	..	..	1186
North Island	New Playmouth	101	104	95	121	165	151	165	145	111	118	128	121	1525
	Gisborne	60	77	88	87	87	135	108	117	92	64	50	88	1053
	Napier	..	..	..	..	..	..	..	..	..	..	..	..	802
South Island	Christchurch	52	41	58	61	70	65	66	59	41	43	49	50	655
	Timaru	..	..	..	..	..	..	..	..	..	..	..	..	541
Norway	Ås	49	35	48	39	60	68	81	83	90	100	785	100	785

	Koppang	31	22	25	30	48	66	84	75	68	63	43	35	590
	Tonstad-Nettfed	182	126	136	74	102	104	107	142	207	238	232	195	1845
	Leikanger	97	63	69	36	38	50	57	75	129	128	118	119	979
	Steinkjær	98	76	72	57	44	54	71	66	111	111	89	111	960
	Bodø	86	64	68	52	46	54	92	88	123	147	100	100	1020
	Kautokeino	20	15	18	15	20	36	67	57	42	31	22	17	360
USA														
West	Sacramento (California)	94.7	72.9	65.3	29.5	6.9	3.0	1.3	1.8	9.4	27.4	69.0	64.0	445.0
	Glasgow (Montana)	9.4	6.9	10.4	17.5	45.0	53.6	43.7	34.3	25.4	15.5	7.1	9.70	278.4
Midwest	Huron (South Dakota)	10.4	17.3	42.2	53.1	72.9	85.1	67.8	50.0	43.7	37.3	18.3	11.9	510.0
	Grand Island (Nebraska)	11.7	18.3	48.0	63.5	97.0	99.3	71.9	71.6	72.4	34.3	26.4	18.0	632.5
	Minneapolis (Minnesota)	24.1	22.4	49.3	61.5	86.1	102.9	89.7	91.9	69.1	55.6	39.4	27.4	719.3
	Peoria (Illinois)	38.4	36.1	73.9	95.8	94.0	101.3	106.7	78.7	98.3	67.3	68.3	62.0	920.8
South	Dallas (Texas)	46.5	55.4	70.4	88.9	124.0	75.7	58.7	56.1	86.1	89.4	58.2	46.7	856.0
Northeast	Harrisburg (Pennsylvania)	72.1	74.4	83.3	82.3	108.2	97.8	91.2	84.1	89.2	74.4	89.4	82.3	1028.7

Appendix 6

Distribution of cultivated land by slope gradient

	1000 km^2	Percent
Slope gradient < 1:8	5.8	67
Slope gradient 1:8 -1:5	1.3	15
Slope gradient 1:5-1:3	1.3	15
Slope gradient > 1:3	0.2	3
Total[1)]	0.8	100

1) Permanent grassland and surface cultivated land for mowing and pasture are not included.

Source: Norwegian Institute of Land Inventory.

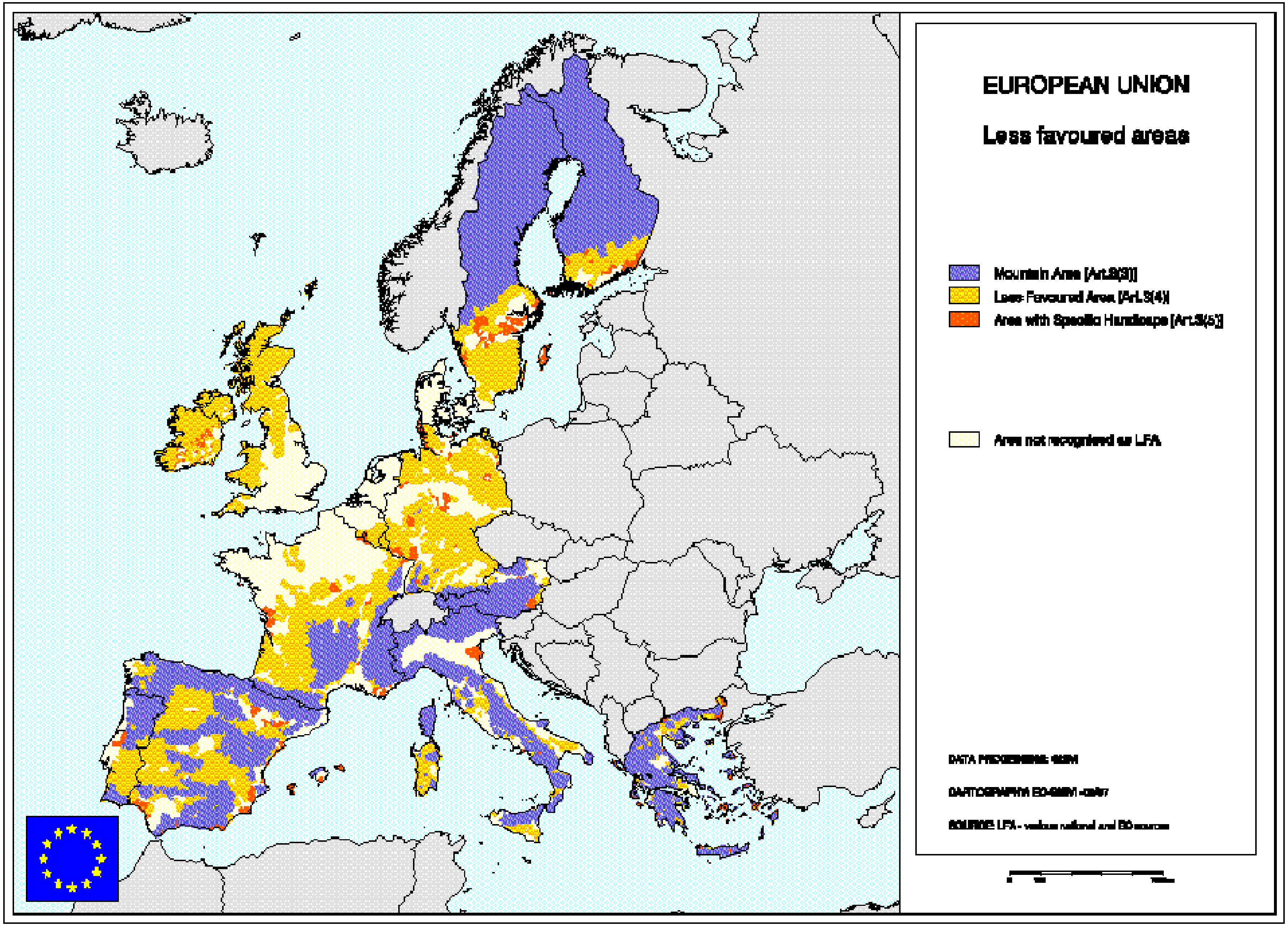
Average field size and average number of fields per farm in Norwegian counties

County	Field size (ha)	Fields per farm
Østfold	3.2	6
Akershus/Oslo	3.1	7
Hedmark	2.2	7
Oppland	1.8	5
Buskerud	2.0	5
Vestfold	2.6	6
Telemark	0.9	7
Aust-Agder	0.6	9
Vest-Agder	0.8	6
Rogaland	1.9	3
Hordaland	0.9	2
Sogn og Fjordane	1.2	2
Møre og Romsdal	1.0	7
Sør-Trøndelag	1.3	9
Nord-Trøndelag	1.9	7
Nordland	0.8	10
Troms	0.4	14
Finnmark	1.3	5
Whole country	1.5	6

Source: Norwegian Institute of Land Inventory
Norwegian Agricultural Economics Research Institute

Appendix

Kilde: EU 1999



Appendix 8

Number of farms by type of production

	Total holdings[1)]	Total cattle holders	Total dairy cow holders	Total sheep holders	Total grain holders	Total wheat holders
Australia[2)]	142 480	88 790	14 190	44 480	36 870[7)]	
France[3)]	734 800	331 900	158 600	100 000	398 740[8)]	287 200
New Zealand[4)]	66 780	32 980	14 740	16 740	1 690[9)]	
Norway[5)]	79 260	31 870	22 790	25 430	23 990[10)]	6 589
USA[6)]	2 057 910	1 167 910	116 680	74 710	430 710[11)]	243 568

1) *Classification of operating units differs between countries.*
2) *Australia: Establishments with agricultural activity with an EVAO of $ 5,000 or more (ABS 1998a) . Wheat is exclusive durum wheat (Eurostat datashop by SSB).*
3) *France: (Eurostat 1998).*
4) *New Zealand: Includes all operating units. (NZS 1997. Dairy farm data from MAF (Ministry of Agriculture and Forestry) 1999a).*
5) *Norway: Units with at least 0.5 ha agricultural land in operation (SSB 1998). Data on number of wheat holders supplied by Bjørlo (SSB).*
6) *USA: Any establishment from which $ 1,000 or more of agricultural products was sold or would normally be sold during the year. As of 1997 (USDA 1998). Wheat inclusive durum wheat (NASS 1999b).*
7) *Farm type classification based on ABS classification; Grape growing (Anzsic code 0121) and grain-sheep/beef cattle farming (Anzsic code 0122). Data from ABS 1998a. Presumably, these represent the majority of cereal farms.*
8) *Total grain holders includes farms with cereals (wheat, durum wheat, rye, barley, oats, grain maize, rice, other cereals) and is thus more broadly defined (incl. maize and rice) than in other countries. Data from Eurostat datashop, Agreste 1998 and Eurostat 1998.*
9) *Farm type classification based on NZS classification: Cropping (Nzsic code 11161), sheep farming with cropping (Nzsic code 11124), cropping with sheep (Nzsic code 11162) og cropping with other (Nzsic code 11163). Data from NZS 1997.*
10) *Total grain holders includes farms with acreage used for grain and oil seeds. Data from SSB 1998.*
11) *Farms with corn, sorghum, wheat and other small grains. Source: NASS 1999b.*

Appendix 9

Distribution of wheat-growing farms in Norway by county – 1997.

County	Number of farms	Total acreage (ha)	Average wheat acreage per farm (ha)
Østfold	1069	8474	7.9
Akershus	553	4397	8.0
Oslo	4	48	12.1
Hedmark	455	5125	11.2
Oppland	287	2279	7.9
Buskerud	642	4795	7.5
Vestfold	1062	8916	8.4
Telemark	229	1287	5.6
Aust Agder	16	49	3.1
Vest Agder	4	10	2.7
Rogaland	11	48	4.4
Hordaland	2	3.8	1.9
Sogn og Fjordane	8	31	3.9
Møre og Romsdal	3	0.8	0.3
Sør Trøndelag	14	40	2.9
Nord Trøndelag	33	136	4.1
Nordland	3	0.5	0.2
Troms	3	0.3	0.1
Finnmark	0	0	0

Adapted from the "Agricultural subsidy database", as of 31. Sept. 1997 (Statens kornforretning 1999).

Appendix 10

Agricultural labour input in France and Norway

	Total labour input. (1000 man-years)	Total labour input (1000 hours)	Farmland in operation (100 ha)	Man-years/ farmland in operation (per 100 ha)	Labour input in hours/ farmland in operation (per 100 ha)	Family labour input (1000 hours)	Hired labour (1000 hours)	Family labour of total labour input (%)
France [1)]	1 015	1 827 720	293 460	3.5	6 228	1 440 900	386 820	79
Norway [2)]	90	169 000	10 383	8.7	16 277	161 000	17 000	95

1) *One man-year (annual labour unit) is defined as 1800 hours. Source: Eurostat (1998).*
2) *One man-year (annual labour unit) is defined as 1875 hours. Source: SSB (1998).*