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RURAL CHANGE

The Challenge for Agricultural Economists

PROCEEDINGS

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Edited by
Glenn Johnson, Department of Agricultural
Economics, Michigan State University, USA
and
Allen Maunder, Institute of Agricultural Economics
University of Oxford, England

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Gower

EIVINDELSTRAND

Sub-Arctic Farming

WHAT IS SUB-ARCTIC FARMING?

I have not found any clear definition of the concept "sub-arctic farming". The word "sub-arctic" naturally reminds one of similar concepts as tropical, sub-tropical, temperate and arctic zones. According to this the sub-arctic zone must be the area between the temperate and arctic zones. This means areas of the earth located fairly far north, close to the polar circle.

I have not given the concept "sub-arctic" such a clear limitation. The reason is, that when I was asked to present a paper on sub-arctic farming, I understood that the programme committee wanted a paper concerning agriculture in the northern parts of Canada, Scandinavia and the Soviet Union. It is especially in these areas that we find agriculture under hard climatic conditions, which differ clearly from agriculture in the temperate zone.

If you look at the southern hemisphere and are moving northwards, you find only oceans in all directions. The south point of South America is located at 56°S. latitude, and the south point of New Zealand at 47°S. latitude. On the northern hemisphere we find that the 60°N. latitude passes close to Oslo, Stockholm and Helsinki, moves further into the middle of Siberia in the Soviet Union, fairly far north in Canada and touches the south part of Alaska. In other words, it is only in the northern hemisphere that we find areas of interest to study in connection with sub-arctic farming.

The extension of arable agricultural land towards the north varies substantially from one country to another. In Scandinavia we find arable land up to 71°N. latitude, while in Canada we only find rather small areas of arable land farther north than 55–60°N. latitude. Also in the Soviet Union we find that the northern extension of arable land is further south than in Scandinavia.

One way of limiting the sub-arctic farming area might be to define it as the areas located north of the boundary at which wheat and barley may be profitable to produce. On the map of Scandinavia in Figure 1 I have

drawn these boundaries for barley and wheat. In Canada we find most of the wheat and barley in south Alberta, Manitoba, Saskatchewan, Ontario and Quebec, i.e. south of the closed boreal forests, see Figure 2. In the northern part of the Soviet Union we find mostly forests and rough grazing land, see Figure 3.

In Table 1 is shown some basic data from countries with sub-arctic farming.

It is only for Scandinavia that I have been able to get separate data for northern and southern parts. According to what I have said and shown on the maps I will reckon the whole of Alaska, most of the land areas in

TABLE 1 *Some basic data for countries having sub-arctic farming within their borders*

	Fin- land	Swe- den	Nor- way	Ice- land	Can- ada	Ala- ska	USSR
Population, million	4.6	8.1	4.0	0.2	21.6	0.4	242.0
of which in north %	13	15	12	—	..	—	..
Arable land, 1000 ha	2641	3342	900	2431 ¹	69830	10 ²	233307
of which in north %	16	11	9	—	..	—	..
Forests in 1000 ha	18697	23466	8330	27	322281	53568	914900
of which in north %	58	56	19	—	..	..	..
Cattle in 1000	1763	1878	944	62	13704	8	111034
of which in north %	20	12	9	—	..	—	..
Pigs in 1000	1193	2556	701	7	5485	..	57900
of which in north %	3	3	1	—	..	—	..
Sheep in 1000	180	330	1782	740	523	5	141436
Reindeer in 1000	135	170	166	..	..	..	..
Arable land/farm, ha							1000 ³
Whole country	11	26	8	23 ¹	171	..	5000
In north	8	15	5	..	..	..	..
In south	14	28	10	..	..	..	..

.. Data not available to the author

¹ Rough grazing land, meadows and permanent grassland included.

² 950 000 hectares of rough grazing land, meadows and permanent grassland in addition.

³ Collective farms.

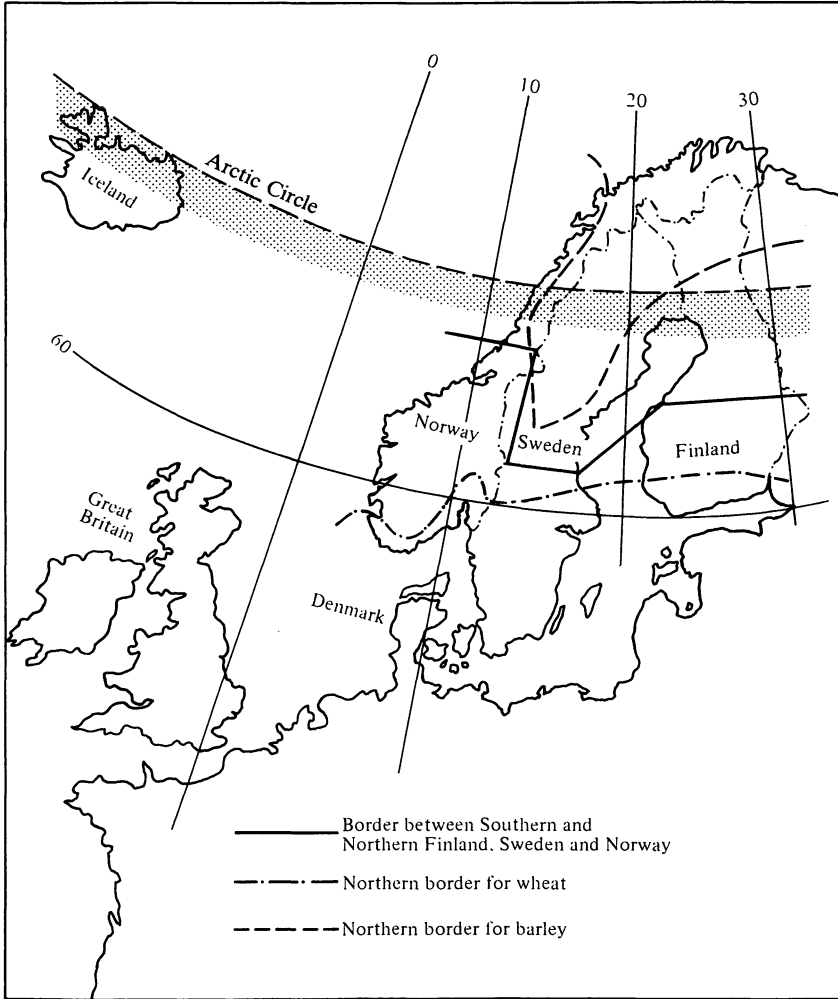


FIGURE 1 Scandinavia and Iceland

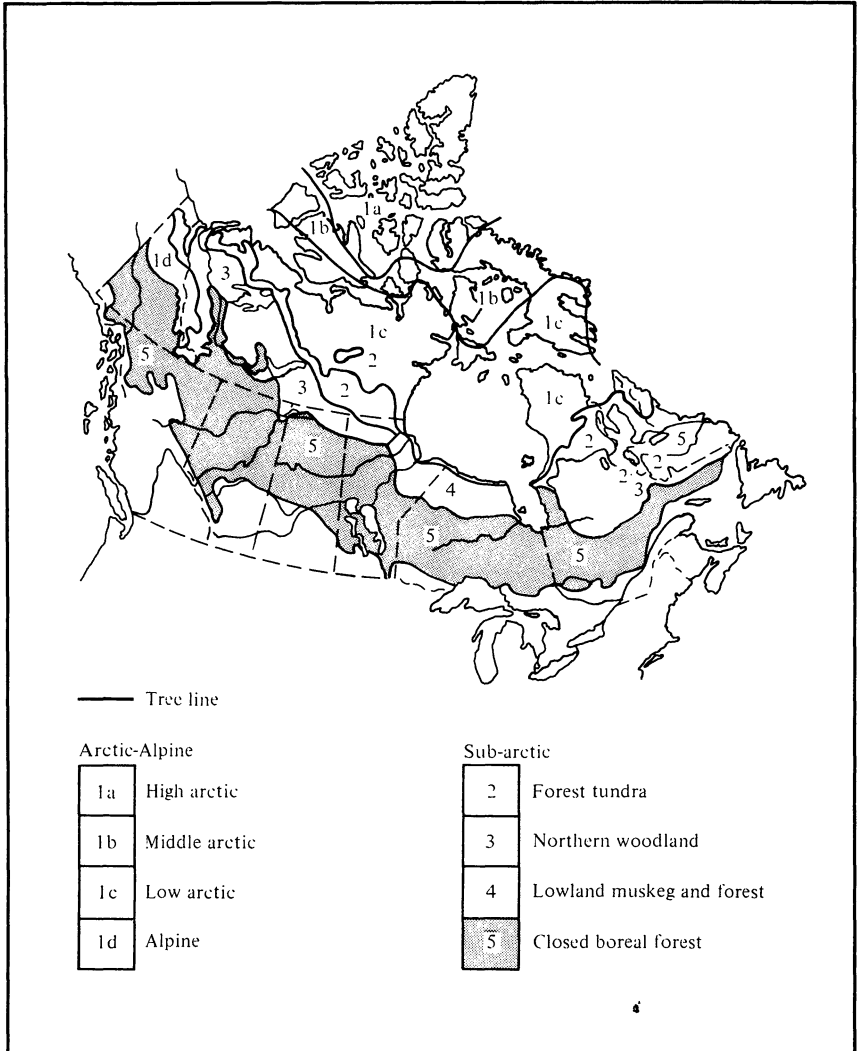


FIG. 2 Vegetation of Arctic and Sub-arctic Canada *Source: Wonders (22)*

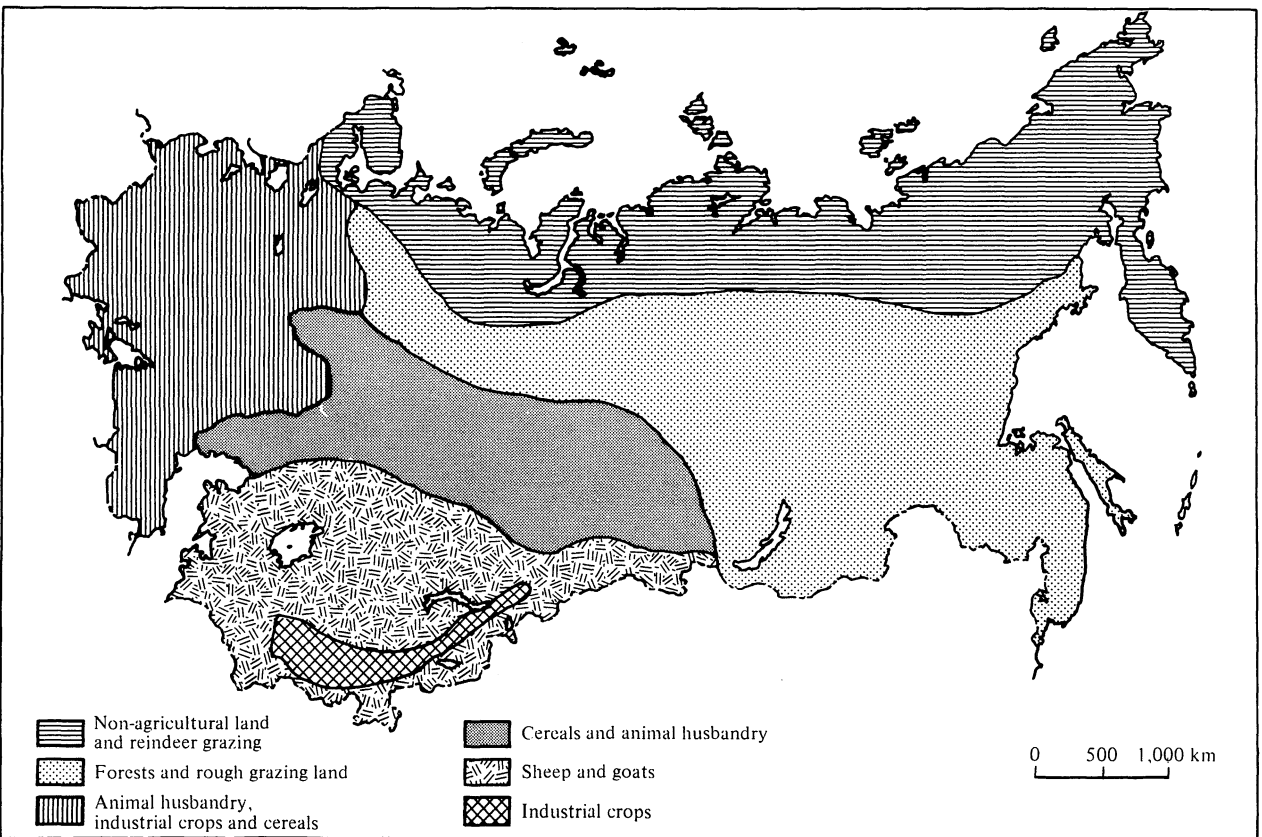


FIG. 3 Types of farming in the Soviet Union Source: IAAE (5)

Canada, half of Scandinavia and the northern part of the Soviet Union as areas with sub-arctic farming.

Within these boundaries you will find a rather limited area of arable land. It is a sparsely populated area. You find large areas of rough grazing, mainly in the northern part of the Soviet Union, Alaska, Northern Canada, Iceland and Northern Scandinavia. In the southern part of this sub-arctic area you find huge areas of cool coniferous forests with rather small plots of arable land within.

In my further analyses I will pay most attention to conditions in Scandinavia, and especially my native country, Norway.

SOME SPECIFIC PROBLEMS OF SUB-ARCTIC FARMING

In the following I shall try to summarize some of the main problems with which sub-arctic farming is faced.

Few alternatives for farming

Agriculture in the sub-arctic areas is dominated by grass production. Thus, dairy, sheep and goats are important enterprises. In the northern part and in the mountain areas with rough grazing land we find reindeer. The choices between types of farming are limited. You find some agriculture based on concentrate feed, but experience shows that these enterprises decrease as we move northwards in Scandinavia (see Table 1).

Smaller farms in Northern than Southern Scandinavia

It is interesting to notice that the farms get smaller as we move further north (see Table 1). Why should it not be the opposite? From an economic point of view we should think that farms ought to be larger as the average yield per hectare is getting lower. In North America we find this is so. The largest farms are found on the prairies, with low yields per hectare. One reason for the existence of small farms in Northern Scandinavia may be the natural conditions, i.e. there are many small plots of arable land which it is difficult to amalgamate and to operate in larger units. Another reason may be of an historical nature. In olden days the agriculture was based on self-sufficiency on the individual farm. A third reason may be the short summer seasons, and the fact that one family is able to harvest a smaller area of grass in Northern Scandinavia than in Southern Scandinavia. In Denmark for instance, they can start work in the fields in the middle of April, while the farmers in the Northern part of Norway can only start in the beginning of June. In the fall the Danish farmer can work in the fields until October and perhaps November, while the farmers in Northern Norway must finish in August or in the middle of September.

Low productivity

The short summers in the north force the farmers to have some over-

capacity in their labour and machines in order to manage all their work during the season. This phenomenon together with small farms and low yields per hectare will necessarily lead to lower productivity.

With respect to yields it can be mentioned that the averaged yield of barley in South Sweden is about 4000–4500 kilo per hectare compared to 2500–3000 kilo per hectare in North Sweden. In Table 2 is shown the average yield of barley in various countries in Europe.

Besides the lower yields in Scandinavia compared to countries farther south in Europe, we also notice that the increase in yield per hectare per year is lower in Northern Europe.

Analyses clearly indicate that the increase in productivity in agriculture in Northern Norway is much lower than in Southern Norway. It seems also clear that the productivity of the total agriculture of Norway increases at a lower rate than in countries farther south (see Figure 4).

COMMENTS ON VARIOUS ENTERPRISES

Forestry

When I mention forestry first, it is because of its dominant role in the sub-arctic farming areas (see Table 3).

The part of the coniferous forest called "cool coniferous forest" (mainly spruce and pine) has probably more than 90 per cent of its extent in Canada, Scandinavia and the Soviet Union. Obviously, the great forests will influence agricultural production structure in these areas. In Scandinavia we also find that the combination of forestry and agriculture is very common. About 25 per cent of all the holdings in Sweden and Norway are combined with forestry. These farms are supposed to have about 20 per cent of the total forest areas in these two countries. A typical farm in Norway with combined agriculture and forestry would have about 10 hectares of arable land, 10 milk-cows and about 25 hectares of forest land.

TABLE 2 *Yields per hectare of barley in some European countries*

	Yield in kilo per hectare 1972/74	Increase in yield. Kilo per hectare per year 1967/70–1972/74
Finland	2260	26
Norway	3270	52
Sweden	3380	80
Denmark	3960	24
France	3840	128
West Germany	4020	90
Great Britain	4040	100

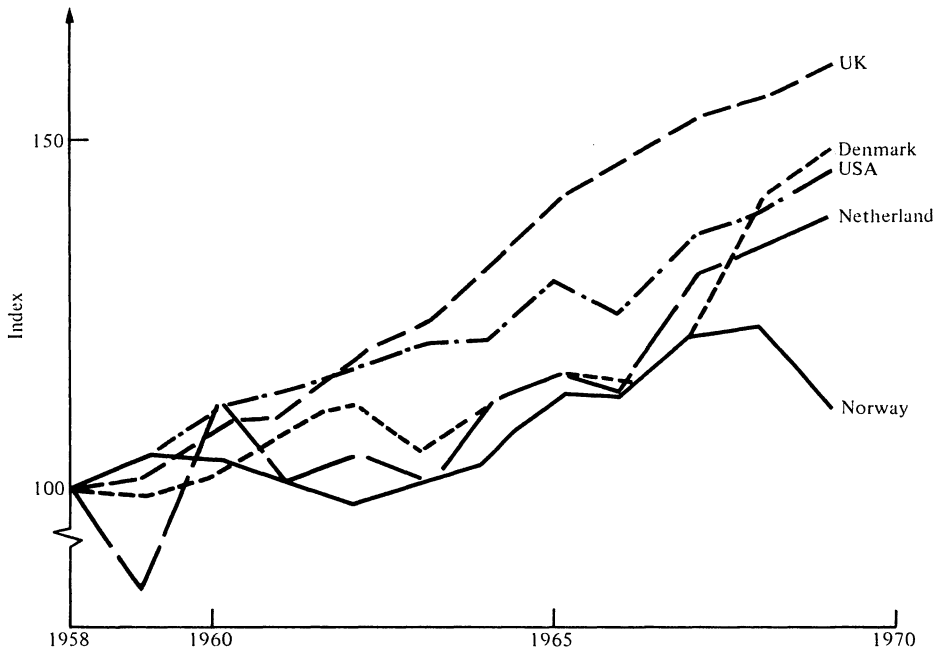


FIG. 4 Changes in net productivity Source: Romarheim (13)

TABLE 3 *Coniferous forests: million hectares*

USSR	553
North America	400
Europe	75
of which in Scandinavia	36
Other countries	112
Total	1140

Dairy

This is the most important farm enterprise in northern Scandinavia. However, there seems to be a limited market for milk products in these areas, because of the sparse population. In Norway for instance, we find that about 9 per cent of the dairy production is located in Northern Norway, while the area has about 12 per cent of the inhabitants. The figures for Sweden are of similar size, while Finland has a somewhat larger proportion of its cattle in the North compared to its proportion of the population (see Table 1).

The dairy production in these northern areas is based on grass from local areas and concentrate feed imported from regions further south. The production is characterized by short grazing seasons and cold winters. Thus, there is a need for expensive insulated buildings in order to carry out the production during a long winter season. A typical dairy family farm may have 10–15 hectares of arable land and 12–15 milk-cows.

Sheep

Sheep farming is quite common in Norway. It is more common in Norway than in Sweden and Finland. In Iceland sheep is the most important type of production. Norway has 1.7 million sheep while Iceland has 0.7 million sheep. This is very few compared to Great Britain which has 26 million sheep and Australia and New Zealand which have 232 million sheep together.

A typical sheep farm in Norway will have about 5–10 hectares of arable land and 80–120 sheep in the winter time. In addition the farms have access to sufficient rough grazing for their herds during the summer season. It is very common to combine sheep and dairy in many parts of Norway. These farms will have about 50 sheep and 8–12 milk-cows.

Reindeer

In Northern Scandinavia we find reindeer. However, we must go to Alaska and the Soviet Union to find the large areas suited for reindeer. A typical Norwegian family farm based on reindeer will have about 230–350 reindeer.

HOW TO MAINTAIN AGRICULTURE IN THE SUB-ARCTIC AREAS

It is well known that the agricultural population has decreased drastically in all the industrialized countries during the last decades. This is also the case in Scandinavia, and forecasts seem to prove that about 3–5 per cent of the total economically active population will have their work in agriculture in the future. This may have drastic consequences for agriculture in many regions of Scandinavia, and especially for regions which are sparsely populated. Obviously, it raises a conflict between the goals of establishing a productive agriculture on one hand and the wish for maintaining viable communities on the other hand. This problem has been focused in the agricultural policy discussions in Scandinavia, and particularly in Norway. In a report from the Norwegian Parliament in 1977, "On Norwegian Agricultural Policy", it is stated that great emphasis should be laid on the possibility of establishing viable communities in the rural districts of Norway. Expansion of agriculture in these areas is looked upon as an important measure for reaching this goal.

However, are there also other reasons for this change in agricultural policy? Let us make a short historical review. During the last decades agriculture in Northern Scandinavia has been reduced. This may be explained by the general competition in producing agricultural commodities. Internationally we had surpluses of several agricultural products until 1974. Consequently, many of the least competitive areas for agriculture were reduced or abandoned. In 1974 there was the international wheat crisis, and several countries changed their policy regarding their productions volumes. They wanted to be self-sufficient for the most important agricultural commodities. This was also the case in Norway which has a very low degree of self-sufficiency (40–50%). The agricultural policy is now based on an increase in the volume of agricultural production. The land resources in the marginal areas should also be considered. Furthermore, it is desirable that a certain degree of self-sufficiency is attained within the various regions. For instance, it is desirable that Northern Norway should be self-sufficient for fluid milk.

Strong measures are needed to maintain agriculture

This is obviously seen in the light of the different natural and climate conditions we find in much of the areas of sub-arctic farming. It is also necessary if you want to give these farmers an equal income compared to the farmers farther south. In Norway several investigations in this field have been carried out. In Table 4 I have shown some figures indicating the differentiation of product prices and direct payments to the farmers in northern and southern Norway.

In order to get more exact data for how strong a differentiation is needed, several model-farms have been worked out for Norway. Altogether there are 17 model-farms which are supposed to cover the country with respect to region, size of farm and type of farming. In Table 5 is shown two

TABLE 4 *Differentiation of agricultural support to farmers in Southern and Northern Norway. Based on a farm with 14 hectares of arable land and 15 milk-cows.*

Year 1976. US\$ per farm.

Type of support	Southern Norway	Northern Norway
Price support ¹	—	7,600
Direct payment of various kinds	4,800	6,400
Sum	4,800	14,000

TABLE 5 *Model-farms in Norway used as a basis for estimating the necessary differentiation of product prices and supports. Also used to measure the income level in agriculture versus other industries.*

Year 1977. US\$

	Southern Norway	Northern Norway
Arable land, hectares per farm	22	12
Milk-cows per farm	18	12
Labour, hours per year	3900	3300
Net factor income per farm	24,100	18,900
Family labour income per farm	19,600	16,100
Labour income per man-hour	5.90	6.60

models of which one is located in Southern Norway and the other in Northern Norway.

It will be noticed that the farm in Southern Norway is larger than the comparable farm in Northern Norway. Further, we notice that the difference in income has been substantially levelled out by means of various kinds of agricultural measures during the last years. The future goal is to reach even more complete parity regarding income. As mentioned in the table, the models are also used to compare income in agriculture and industry. In 1976 the Parliament of Norway decided that farmers gradually should be given the same level of income as industrial workers. This goal shall be reached by 1982. According to the latest estimates (1979) farmers' incomes are now 95 per cent of the incomes of industrial workers.

An important question is the level of productivity which should be used in the farm-models. This question is solved by negotiation, and the

productivity level is adjusted from period to period. It is accepted that productivity is lower in North Norway compared to South Norway.

Also in Finland and Sweden it is accepted that extra supports are needed for farmers in the northern areas. We find various kinds of investment supports and direct payments. At present (1967–77) the *differences* in the price of milk between southern and northern parts of Finland, Sweden and Norway are as follows:

	US\$ per litre	US\$ per gallon (= 3.79 l)
Finland	0.079	0.30
Sweden	0.061	0.23
Norway	0.074	0.28

However, in spite of these extra price supports on milk and other extra government grants, the farmers in North Scandinavia attain a relatively lower profitability than their colleagues in South Scandinavia (business year 1975 in Finland and 1976 in Sweden and Norway):

	South	North
Finland	100	83
Sweden	100	88
Norway	100	92

Production structure and type of farming in sub-arctic areas. What is natural?

What is the optimum farm structure: small units as we find them in North Scandinavia or large units as we find them in Canada and the Soviet Union? Norway had chosen an agriculture policy which to a great extent allows the small unit to exist. One argument has been the natural conditions which make it difficult to establish large farm units. Another argument has been the fear of depopulation of many rural districts in North Norway. In North Sweden they want larger units and the natural conditions are also more appropriate for this. In a Swedish report concerning the establishment of viable farms in Northern Sweden it is stated that the farms must at least have 22–30 hectares of arable land, 30–35 milk-cows and forest land in addition.

The farm sizes I have mentioned from Scandinavia are very small compared to what we find in, for instance, Canada (see Table 6).

The figures from Canada are average for the whole country. I will guess that the figures for the sub-arctic areas in Canada are somewhat different.

The choice between alternatives for farming may include several problems. An important question is whether one should choose a labour-consuming type of production, as for instance milk, or a less labour-consuming production, as sheep and reindeer. In Iceland many farmers have chosen sheep, probably because of the quality of the rough grazing which does not allow intensive dairy production. Many places in Iceland also have the problem of land erosion. The rough grazing areas may easily be overcrowded with sheep and often the result is increased wind erosion.

Another important question relates to the enterprises based on con-

concentrate feed, for instance pigs and broilers. By locating these types of production to sub-arctic areas you often get extra transport costs both of concentrate feed and of the final commodity.

As mentioned earlier, the combination of agriculture and forestry seems to be a very important type of activity in Scandinavia. Earlier, the combination of agriculture and fishery was very common along the Norwegian coast and in the northern areas of Norway. However, this combination seems to be decreasing very rapidly.

Individual versus regional plans

The need for co-ordination of the plans for the individual farm and the plans for the total region seems to be more important in many cases in the sub-arctic areas than is found in the typical farm regions further south. The reason is partly the limited resources that should be divided between several farmers and partly that an increase in the production in one area will make it difficult to increase the production in the adjacent region due to the limited market for agricultural products in the local area. In other words, which region should be allowed to increase production? Or to what extent should production be increased in the various regions in order to attain an optimum use of the total resources and a balance between supply and demand for agricultural commodities? Also in Scandinavia several complicated econometric models have been worked out to solve the question of distribution of agricultural production among regions. However, I think there is a long way to go before we may say that these models give the complete answer to how agriculture in the sub-arctic areas should be organized.

How to establish viable regions in sub-arctic areas? The multiplier effect of agriculture and forestry. The need for other industries

An important task in the sub-arctic areas is to create satisfactory production and social surroundings for farming. One problem is the long distances to the processing industries for agricultural and forest products. Another problem is schools, health services, transportation facilities, shops, agricultural extension services and other social services that are

TABLE 6 *Average size of farms in Canada.*

Types of farming	Average size, hectares per farm
Wheat	270
Cattle, pigs and sheep	208
Livestock combination	135
Dairy	78
Mixed farms	135
Forestry	144

needed in a modern society. Much attention is paid to these problems in Norway, and not least in Northern Norway. Complete plans that include agriculture, forestry, industries and service institutions have been carried out for this part of the country. The aim of these plans has been to maintain the population in the area. Several measures have been utilised to encourage new industry to move into the region (regional development fund).

Agricultural economists are responsible for the agricultural part of this problem. In Norway the economists have been interested in measuring the multiplier effect of agriculture with respect to employment and income. The idea behind this is that agriculture creates activities for agricultural and forest processing industries, for the transportation system and for the service industries in the region. As an example it was found that the total employment in agriculture and forestry in a Norwegian region was 2,250 man-years. The indirect employment was estimated to be 830 man-years. Thus, the direct and indirect employment amounts to 3,080 man-years, and the multiplier effect of agriculture and forestry was $3080/2250 = 1.4$. Similar analyses have been carried out with respect to the factor income in the region. It was found that the total factor income in agriculture and forestry in the region was 7.2 million US\$, whereas the indirect or multiplier effect was 4.6 million US\$. That means a total impact of 11.8 million US\$ altogether, or a multiplier corresponding to $11.8/7 = 1.6$.

The investigations indicated that the multiplier effect varied substantially from one industry to another. Analyses of this kind should be very useful in planning the set of industries and services that are needed in a region to create the necessary employment, if this is an important goal.

Also in Northern Sweden and Finland substantial support is given to manufacturing industries which want to establish themselves in the area. It is increasingly realised that it is necessary to make regional agricultural policy more a part of general developing area policy.

However, we also have a competition between agriculture and other occupations, and this competition may be even harder in the sub-arctic areas with low productivity in agriculture. In connection with the new oil activity in the North Sea, many politicians feared that low income industry including agriculture would be left along the Norwegian coast. Several investigations have been carried out in order to shed light on this problem. Agricultural economists have also been involved. Surprisingly, very few farmers took part in the oil industry, in spite of substantially higher wage rates compared to agriculture. Those farmers who took part still kept their farms, but reduced their activity in agriculture. This was the short run implication.

Altogether, several investigations seem to prove that low income industries including agriculture may exist side by side with high income industry. The explanations may be more or less security for future employment, environmental differences from one industry to another and personal preferences. In Norway, another explanation may be the

increase in income that is promised by the Government. So far, there seems to be a sufficient number of people, and also young people, who want to go on with farming also in the sub-arctic areas of Norway.

Finally, part-time farming should be mentioned, which is practised on two-thirds of all Norwegian farms. I have mentioned the combination of forestry and agriculture, but just as common is the combination of agriculture and industry. What happens in many areas with growing industry outside agriculture is a change to less labour-consuming enterprises in agriculture and thus an increase in the number of part-time farmers.

CONCLUDING REMARKS

The item "Sub-arctic farming" is placed under "Micro-level, plenary session", and many readers might certainly have expected more evaluations of typical micro economic problems. When I have emphasized the macro economic and agricultural policy aspects, it is to stress the importance of clear goals when advising the individual farmer in these areas. It may be a waste of resources to establish agricultural units which may be left or substantially reduced after a short period of time. Or let me put it in another way. The process of working out individual plans for the sub-arctic farmers includes almost the same problems as you find in regions further south. The enterprises may be somewhat different and the choices between type of farming are more limited compared to the situation in the south. However, the principles for estimating optimum solutions on individual farms are the same. What is really different may be the market situation, far distances, risky conditions and the lack of environmental stimuli. Thus, I have laid stress on the need for complete plans for the sub-arctic regions that include all activities, also those outside agriculture.

I have raised questions like: what is the desirable size of the farm and what types of farming should be preferred? What kind of agricultural policy measures are needed to maintain agriculture in these areas? Other questions might have been raised, such as how should the agricultural extension service be organised in sparsely populated areas, i.e. private or public? The municipalities in the sub-arctic areas are often economically weak, and what kind of aid should be given to these municipalities in order to improve agriculture and other activities? What type of non-agriculture industries should be preferred, and what about the infrastructural investments?

We have been in a period in which the importance of sub-arctic farming has been declining. This has mainly been caused by the surplus tendencies of agricultural production, and due to the fact that sub-arctic farming has lost its market proportion because of less productivity compared to agriculture farther south. My analyses also show that total farm production in the sub-arctic areas counts for a rather small part of the total agricultural production in the world. Anyway, this is the situation if we

keep the wheat-producing areas in Canada, Scandinavia and the Soviet Union outside the sub-arctic area. However, the wheat crisis in 1974 clearly indicated that it may be of interest to maintain – and perhaps increase – agricultural production in the sub-arctic areas. It is also probably true that substantial areas of potential arable land are hidden in the mighty coniferous forests we find in the sub-arctic areas today. Thus, reclamation of new agricultural land is possible in these areas. But is it a wise resource allocation? It might have climatic consequences which we are unable to foresee, and timber might be a scarce resource in the future, just like food.

SELECTED REFERENCES

- Andersen, F.G. and Eid, O. *Combined Agriculture and Forestry*, Norwegian Institute of Agricultural Economics, Oslo 1979.
- Dybdahl, I. and Leiramo, A. *Combined Agriculture and Fishery in North Norway*, Norwegian Institute of Agricultural Economics, Oslo 1978.
- Fågeras, E., Hoffmann, J. and Romarheim, H. "The Multiplier Effect of Agriculture, Forestry, and Agricultural-based Industries in a Rural Area", Report from The Agricultural University of Norway and The Norwegian Institute of Agricultural Economics, 1975.
- Holstrøm, S. *Swedish Farming, Agriculture and combined agriculture/forestry*, Agricultural Economic Research Institute, Stockholm 1977.
- IAAE, *World Atlas of Agriculture*, Instituto Geografico De Agostini-Novara, Italy 1969.
- Knapskog, K. *Agriculture and Oil Industry*, Norwegian Institute of Agricultural Economics, Oslo 1977.
- Kolesnikov, L. "Agriculture of the Soviet Union", published at the XIV International Conference of Agricultural Economists, Minsk 1970.
- Lantbruksekonomiska Samarbetsnämndens Rationaliseringsgrupp: Utvecklingsvegar i lantbruket, Samanfattning av en serie undersökningar, Stockholm 1975.
- Lomacka, L. "Agriculture of Northern Scandinavia", *Nordisk Jordbruksforskning*, hefte 3–4, 1958 og supplement 1960. Published by the Nordic Association of Agricultural Research Workers.
- Oxford Regional Economic Atlas: United States and Canada*, Clarendon Press, Oxford, London 1967.
- Persson, L.O. *Supports to Agriculture in Northern Sweden*. Importance and Regional Consequences. Preliminary report from the Agricultural University of Sweden, Uppsala 1979.
- Persson, R. *World Forest Resources*. Review of the World's Forest Resources in the early 1970s. Department of Forest Survey, Royal College of Forestry, Stockholm 1974.
- Romarheim, H. *The Productivity Development in Norwegian Agriculture*, Norwegian Institute of Agricultural Economics, Oslo 1975.
- Scott Wood, K. *The North Norway Plan*. A Study in Regional Economic Development. The Chr. Michelsen Institute, Bergen, Norway 1964.
- Sigtorsson, B. "Agriculture in Iceland", reprint from *Iceland 874–1974*, handbook published by the Central Bank of Iceland, Reykjavik 1975.
- Symons, L. *Russian Agriculture*. A Geographic Survey. University College of Swansea, G. Bell & Sons Ltd, London 1972.
- Sørland, R. *Reindeer in Norway*, Economic Analyses, Report from the Norwegian Institute of Agricultural Economics, Oslo 1978.
- The Norwegian Parliament "On Norwegian nutrition and food policy", Report No. 32, 1975–76, to the Storting, Oslo; "On Norwegian Agricultural Policy", Report No. 14, 1976–77, to the Storting, Oslo; "The Implementation of the Development Plan for North Norway", Report No. 60, 1976–77, to the Storting, Oslo.

Torvela, M. "Main features of Milk Subsidy", paper presented at a Symposium on the Problems of the Agricultural Development of less-favoured areas, held in Geneva, May 1978. Arranged by FAO and ECE.

Wonders, W.C. *The North*. Studies in Canadian Geography, Montreal 1972.

GENERAL DISCUSSION – RAPPORTEUR: WAYNE E. BURTON

The speaker presented the Northern Scandinavian case of sub-arctic farming as being a peripheral extension of temperate zone farming into the harsh environment of the far-north, and being characterized by small farms, animal agriculture based on grass, low crop yields, high costs, and few alternatives. Constraints were identified as rough topography, short seasons, weak or absent service industries and institutions, distances from factor-input sources, and high costs for infrastructure. Forestry was mentioned as a typical enterprise combination with agriculture in sub-arctic farming. A primary goal for farming in the northern region is to maintain viable communities. The primary policy stratagem appears to be income parity with industrial employment, brought about by regional price differentials and investment supports.

The discussion opened with a description of a second type of northern agriculture; that found in conjunction with industrial developments in the remote locations of the northern Soviet Union. In this case, agricultural production has been developed to support settlement in previously undeveloped areas for the purpose of petroleum, mineral, and transportation industry development. Dairy products, potatoes, and vegetables are produced to satisfy settlement needs and total economic development. Recognition is given to the fact that such agricultural development provides amenity values above and beyond nutritional values. Recognition is also given to the fact that new technology must be created for these northern locations, and is being provided through research institutes developed for that purpose. Capital investment costs are high, and this is met through increased direct government investment in agriculture or through increased industry investment as part of the social cost of development.

A third type of sub-arctic farming would be that found in Alaska and some areas of Northern Canada, ranging from large greenhouses at urban centres, producing vegetables and ornamentals, and large dairy farms, to subsistence gardening and feed production for recreational horses; yet all being few in number. While agriculture was introduced by early fur trading companies and gold miners, it was not incorporated into the indigenous cultures. Reindeer production was introduced by the respective governments for socio-economic development among the indigenous population, but was of limited time duration even though a residual does remain. Quite recently, some three years ago, the situation has changed. Commercial agricultural development has been recognized as a goal of Alaskan socio-economic development. Subsistence gardening is being developed in remote indigenous villages. State project lands, some 24,000 ha. each, are being sold to individuals in 1,200 ha. units. Small-

farm project lands are also being sold in 8 to 64 ha. units. It is anticipated that some 265,000 ha. will be sold to individuals for agriculture-only in the period 1978–1983. Native-claims-settlement lands, some 1.2 million ha., are beginning to come under scrutiny for possible agricultural development by rural villages. Primary purposes for farming development include substantial self-sufficiency for a rapidly growing population which imports more than 90 per cent of food supplies, amenity support for an urban-emigrant population, and socio-economic development in isolated rural areas. The stimulus for sub-arctic farming development in this area has primarily resulted from ongoing petroleum industry developments and the need for socio-economic development in rural village areas.

Questions were raised regarding the boundaries of sub-arctic farming. Responses regarding both Northern Scandinavia and the Soviet Union indicated that this type of farming was north of the grain growing areas. However, subsequent discussion concerning crops that do biologically well in the sub-arctic indicated that breeding changes have extended barley for animal feed to the arctic circle. Other crops that do well in sub-arctic farming areas are improved and wild grasses, rape for silage, many vegetables and potatoes, and several types of berries. While the yields of some crops may not directly compare with more southerly locations others compare quite well, even though only a single crop may be raised. It should be noted that the insular nature of settlement, particularly in the Soviet Union and Alaska, places an importance on sub-arctic farm production beyond the nutritional values obtained. Questions were then raised regarding the critical size of human settlement for communities and sub-arctic farming to survive. Responses indicated that, depending on the degree of isolation, probably some 200,000 to 300,000 in a 1–3 day drive will provide a full range of services that make for permanency of settlement, but in much lesser degrees of isolation, populations of 15,000 may survive quite well. A final question was directed to the willingness of young people to go into farming in the sub-arctic. The response indicated that such was now the case since incomes have improved and many social services are now available.