AGRICULTURE AND DRAINAGE PRACTICES IN FINLAND

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Abstract

The climate and soil conditions are not favourable for agriculture in Finland. In spite of harsh conditions Finland is able to produce all its foodstuffs, even having some overproduction. Drainage is a prerequisite for agriculture. Drainage works are constructed for 33 000 hectares annually. Drainage practices are described.

1. Finland as an agricultural country

1.1 Introduction

Finland is situated in northern Europe between 60° and 70°N latitude. The total land area of Finland is about 337 000 sq.km. Three quarters of this area is forest or peat. Productive forests are some 60 % of the surface area, covering some 20 million hectares. Finland is famous for its 60 000 lakes. These and waterways account for about 10 % of surface area. Only 8 % of the total surface area is arable land, covering about 2.4 million hectares. However, this accounts for fifty per cent of the world's arable land as far north, e.g. in other Scandinavian countries (figure 1).

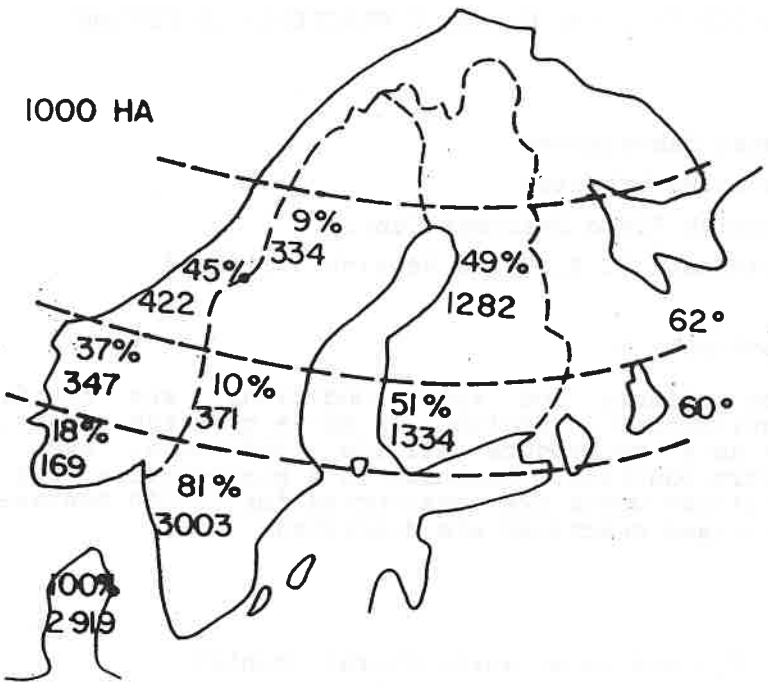

Figure 1. Location of arable land in Scandinavia.

Finland is the northernmost country in which agriculture is practised. This is possible because of numerous highly favourable environmental factors like the low lie of the land, relatively fertile soil, long summer days and the mildness of the climate due to the Gulf Stream. Finnish agriculture has over the years developed a diversified production based on farming, livestock and forestry. Recently, farms with no livestock have been increasing in number in the south and south-west. Also other kinds of specialisation are now becoming more common.

1.2 Climate and soil conditions

Climate

The average annual temperatur in Finland varies between -1 and +5 °C. The temperature may exceed +20 °C in the warmest summer months, being between +13 and +17 °C for July on the average. The long-term mean in February is between -3 and -4 °C. Due to the effect of oceans and the Gulf Stream the average temperature is about 6 °C higher compared with other countries as far north.

Precipitation exceeds evaporation. The mean annual precipitation is 500 - 700 mm, with precipitation highest in the south and east. Half of the precipitation comes during the growing season, and more at the end of the season than the beginning. However, shortage of water occurs in southern and south-western Finland during May, June and July. The rainfall is then only about half of the amount plants lose through evapotranspiration. Part of the annual precipitation falls in the form of snow. The snow cover is thickest in the central, eastern and northern parts of the country.

Soil conditions

The arable land in Finland can be divided into broad regional groupings on the basis of the dominant soil type (figure 2):

- clay areas in south and south-west Finland (1)
- till (moraine) areas in south-east Finland (2)
- silt, peat and till areas in the Lakes Region and south Kainuu (3)
- fine sand areas in Ostrobothnia and north Lapland (4)
- peat areas in Lapland (5).

1 clay
2 till
3 loam,peat
4 fine sand
5 peat

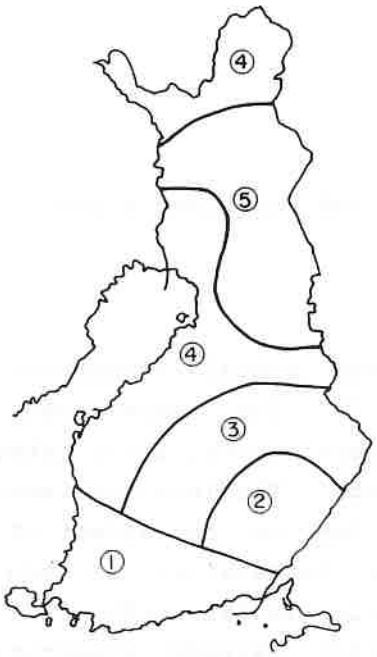

Figure 2. Soil types in arable land in Finland.

The natural humus content of mineral soils is low usually being under 3 %. The humus content of tilled soils is usually 4 - 8 %, lowest in coarse soils and highest in heavy clay.

1.3 Farms

Family farms are typical of Finnish agriculture. There are now about 208 000 farms, their average size being 12 hectares of arable land. Distribution of farms of different size is shown in figure 3. The average farm comprices 35 ha of forest land. The amount of arable land per farm is greater in the south than in the north but farms in the north have more forest. As we move northwards also the emphasis in production changes from cereal cultivation to dairying.

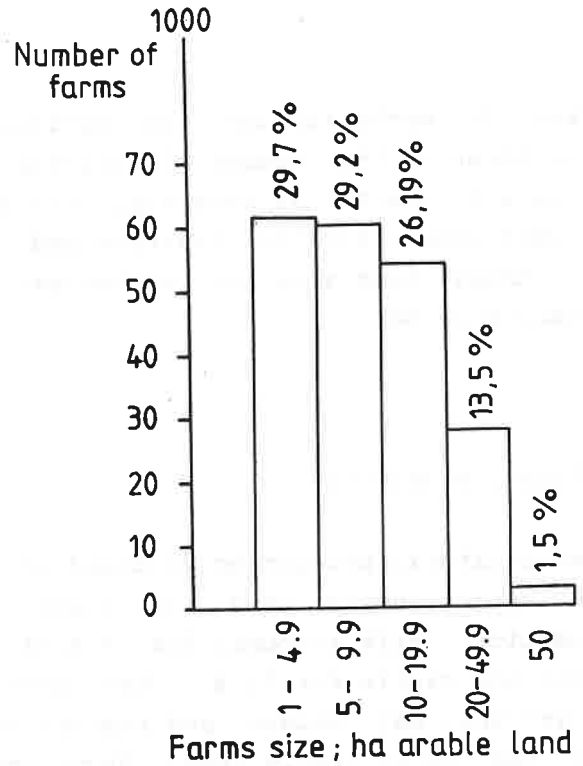

Figure 3. The size and distribution of farms (over 1 ha of arable land)

About 49 % of the farms is owned by full-time farmers. Other farm owners are part-time farmers. Farm population is only 7 % of the total national population (4.9 million in 1985).

A hundred years ago 90 % of the Finnish population lived in the rural areas. The agricultural population peaked at the end of 1920's. The sharp decline in the size of the farm population began only in the post-war period.

Farm machinery

Mechanisation of agriculture has been rapid during the last decades, resulting significant savings in human labour and quicker and more effective farming methods. Some current practices, like drill placement of fertilizer require machinery.

The degree of mechanisation in agriculture is often expressed in terms of the number of tractors and combines because these are regarded as essential field machines. In 1985 there were about 240 000 tractors and 47 000 combines in Finland. Arable land area per tractor was 10 ha and grain area per combine 28 ha.

1.4 Agricultural production

Finnish agricultural production is based on livestock. Only 15 % of the arable land is used for plant production for human consumption. Milk accounts for 38 % of the total value of production and cattle for 53 %, when beef production is taken into account. Hay, silage and pasture constitute about one third of the total arable land. About one third of feed grain is fed to cattle. Figure 4 shows the use of cultivated land.

The specialisation of farming happened in the 1960's and 1970's. Milk used to be produced on almost all farms, compared to only on about 64 500 farms today. About one half of the farms have no livestock. In 1983 there were about 23 000 cereal farms having 10 hectares or more of arable land.

Crop production

About forty different crops are cultivated in Finland. Wheat and rye are the main food grains in Finland. Winter wheat can be cultivated only in the clay soil areas of the south and south-west. Spring wheat also grows best in clay soils in southern Finland. At present it is the most important food grain in south Finland. Rye grows best in light mineral soils. It is cultivated as far north as northern Karelia, central Finland and the central parts of southern Ostrobothnia. Barley is today significant in Finnish agriculture as livestock feed.

In figure 5 yield statistics are presented.

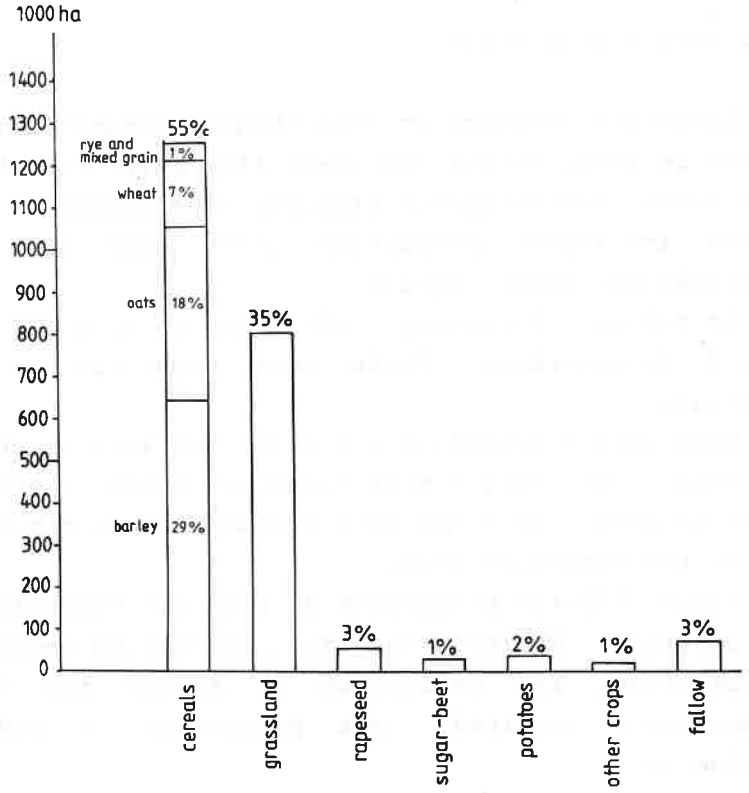

Figure 4. Use of cultivated land in 1985 in Finland.

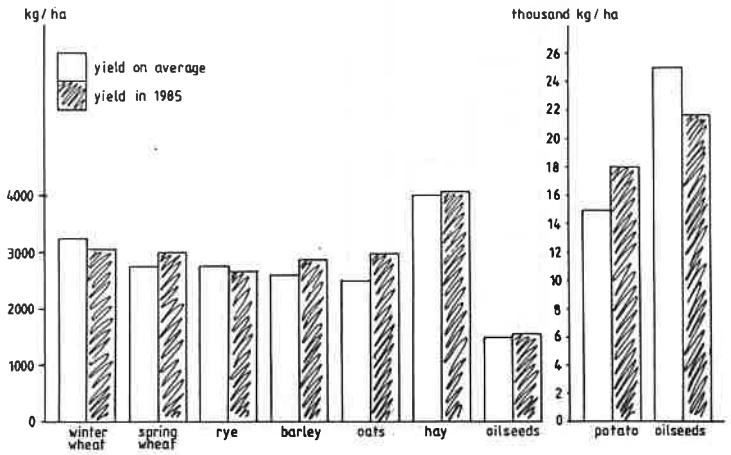

Figure 5. Yields on average and in 1985 of main cereals in Finland.

Livestock production

Livestock production has changed dramatically during the last decades. Horses and sheep like dairy cows have decreased in number since the mid-sixties. The number of hens and pigs have increased. Production units have also grown with increasing specialisation.

At the end of the year 1985 dairy farms accounted for about 30 % of all farms. There were about 628 000 dairy cows in Finland.

With improved feeding and wider reliance on high yielding breeds, the average milk yield has risen to 4 800 litres per cow in 1985. The total milk yield has thus not fallen in pace with the number of cows.

Since 1970 the production of pork has been higher than beef production. Poultry has also increasing importance in meat production. The production of mutton and horsemeat has constantly declined. Meat production in 1985 is shown in figure 6.

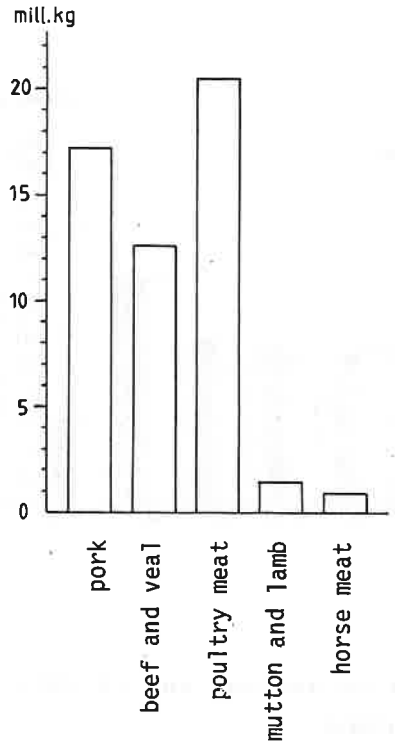

Figure 6. Meat production in 1985.

Self-sufficiency

Self-sufficiency in final products in Finland has been over 100% for a long period. Self-sufficiency in some foodstuffs and vegetables only is below 100% due to the severe climate. Self-sufficiency in milk, eggs and meat has for a long time been over 100%, being greatest in eggs. Also the self-sufficiency in wheat, barley and oats has been over 100% and in rye less than 100%. Annual self-sufficiency is, of course, highly dependant on the annual yield.

2. Draining of arable land

2.1 Main drainage systems

Main drainage systems are mainly constructed with government funding by loans and subsidies, annual amounting to about 20 million FIM, half being loans and the other half subsidies. Since 1960 the construction of main drainage systems has decreased significantly due to funding being now on the level shown in figure 7. At the end of the 1970's only about 5 million FIM was used for the area covered by main drainage, being then only 1600 hectares.

The National Board of Waters and the National Board of Agriculture are involved in this branch of activity, the first board involved in constructing the systems and the latter in financing them.

2.2 Subdrainage

Background

Artificial drainage of arable land is a necessity in Finland because of our climatic and soil conditions. Rapid drying of fields in the spring and during the harvest time is important in order to fully exploit the short growing season. Only 10 per cent of our fields can be cultivated without any drainage because they are located on slopes or the soil is highly permeable and thus self-draining.

Over 1.1 million hectares are still drained by open ditches. At the end of 1985 about 41 % or one million hectares of Finland's arable land were already subdrained. The national target is to get about 800 000 hectares subdrained by the year 2000

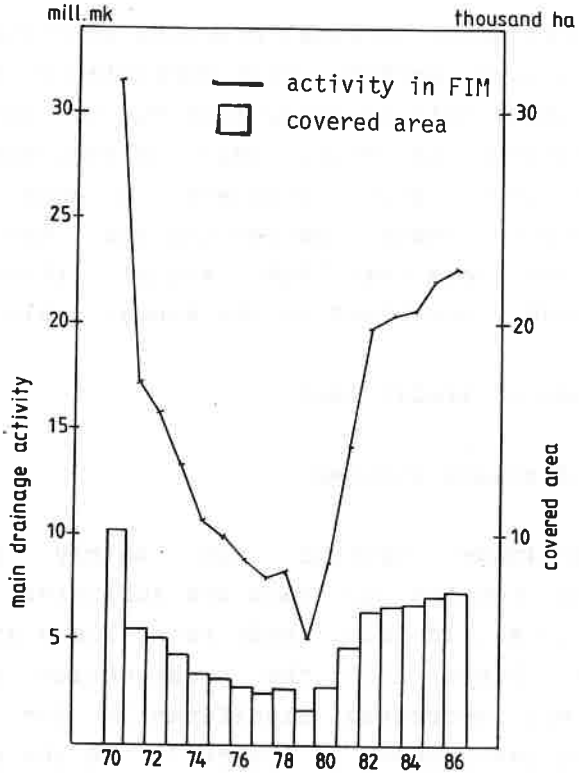

Figure 7. Main drainage activity and investment during 1971 - 85.

The Finnish Field Drainage Centre and drainage planning

Almost 100 per cent of subdrainage in Finland is today based on detailed field surveying and plans drawn up by the Finnish Field Drainage Centre. A plan prepared by the Finnish Field Drainage Centre or the Water District Office is a qualification for government subsidy for subdrainage projects.

The Finnish Field Drainage Centre is an association-form, quasi non-governmental organization that works to promote drainage operations. It works nationwide and has 130 employees of which about 100 are drainage technicians. The association was founded in 1918. Since then subdrainage systems have been constructed according to systematically drafted plans though subdrainage was known in Finland as early as the middle of the 19th century.

Today 33 000 hectares on the average are planned for subdrainage annually. This accounts for about 6 000 plans, their average size being 5 - 6 hectares. The number of plans has been on this level since the 1970's. The number of plans for redrainage or alteration has currently been 1 500 - 2 600 hectares annually.

Subdrainage operations and costs

Mechanisation of subdrainage construction took place in Finland in the 1960's. This was the first step towards more extensive construction of subdrainage systems and is clearly demonstrated by figure 8. Later the invention of plastic pipe and the automatic pipe laying method have also been factors affecting the increase in subsurface drainage construction. Today subdrainage is annually constructed on 33 000 hectares of field area on the average.

Subdrainage costs were 8 000 FIM/hectare on the average in 1985. Of this 40 % is composed of drainage materials, 36 % of construction, 13 % of farm work, 6 % of planning and 5 % of miscellaneous. In recent years drainage costs have increased more than e.g. other building costs in agriculture because of decreased drain spacing. This in turn is a result of the many rainy years in the beginning of the 1980's and the soil compaction that occurred then.

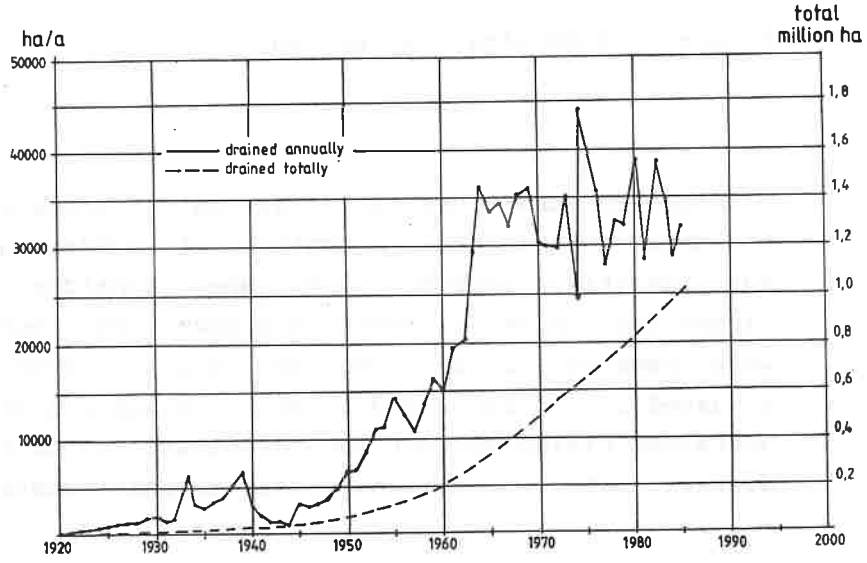

Figure 8. Annually constructed subdrainage systems in hectares

The total investment in subdrainage was about 260 million FIM in 1985 (figure 9). Government loans and subsidies has recently accounted for about 15 - 18 % of total investment. Most municipalities also support drainage mainly by paying drainage planning costs entirely or partly.

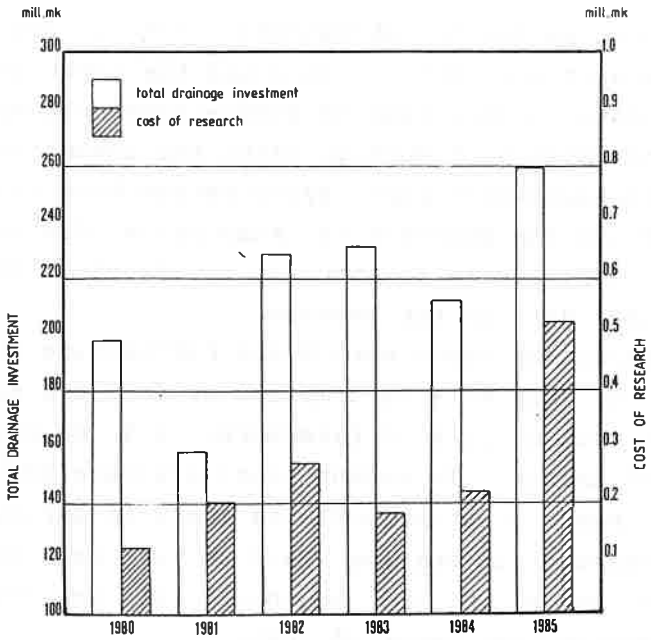

Figure 9. Subdrainage investment.

Completed subdrained fields are mainly situated in southern Finland, where the percentage of subdrainage in some municipalities exceeds 70 %. When considering farm size, larger farms have pioneered drainage and thus subdrainage work remains to be done on smaller farms than before. Situated in central and northern Finland and on small farms, undrained fields present more difficult conditions than the average today, which means higher drainage costs in future.

3. Subdrainage practices

3.1 Planning principles

Finnish Field Drainage Centre has since 1918 provided Finnish farmers with necessary subdrainage plans. During this long time of planning activity a lot of experience has been collected. At the same time a number of drainage experimental fields were constructed.

The reason for the long life-time of subdrainage in this country can be evaluated to be a benefit of following principles:

- Land and soil survey and mapping are allways done before planning
- Drainage plans are stored for later use in the Finnish Field Drainage Centre
- The laterals are placed perpendicularly to sloping
- Gravel is allways used as envelope material
- The gradient design so, that the water velocity is increasing downwards with the current. If the velocity decreases a sludge manhole is placed to the point, where the gradient is changed.
- The high quality of construction work. The bottom of the trench is not allowed to deviate more than 1 cm from marked level. No sludge is allowed in the trench.
- Small diameters of pipes in laterals. These pipes flow water-filled every spring. The sludge will be flushed away because of the high velocity of the water.
- The set up and supervision work done by educated drainage technicians.
- Blind inlets made of gravel are used on heavy clay soils in order to promote the entry of surface water into the drains.
- The minimum gradient by 40 mm pipe is 0.30 %, minimum gradient by 160 mm pipe 0.05 %.
- Drain depth 1.0 - 1.2 meters in mineral soil, 1.2 - 1.5 meters in peat soil.

Table 1. Drain spacings.

	m	m/ha	feet/acre
Heavy clay and loam (silt)	14 - 16	630-700	840-930
Light fine sand	20 - 26	400-500	530-660
Light coarse sand	30 - 40	250-330	330-440
Muddy clay and loam	30 - 60	170-330	230-440
Peat soils	16 - 20	500-630	660-840

Table 2. Runoff values in different soils.

	l/s ha	mm/day	inch/day
Compact soils - level areas	1.0	9	0.35
Peat soil (carex) - level areas	0.8-0.9	7-8	0.28-0.32
Other peat soils	1.0	9	0.35
Loose fine sand	0.8-0.9	7-8	0.28-0.32
Mud and fissured muddy clay	0.6	5	0.20
Compact soils - slopes	0.5-0.8	4-7	0.16-0.28
Slopes - artesian ground water	2.4-4.0	17-35	0.67-1.38

3.2 Construction

Subdrainage systems are constructed in Finland by private contractors. There are now about 280 contractors having drainage as their main occupation and about 130 as a secondary occupation. Drainage machinery in their use is composed of 235 chain-type trenchers, 80 wheel-type trenchers, 345 back-acters, 6 trenchless machines and 4 machines of other type. Chain- and wheel-type machines are almost entirely manufactured in Finland. In addition to these they have about 250 gravelling trailers. About thirty drainage machines are equipped with a laser depth control system.

3.3 Drainage materials

Pipe drainage using clay pipes was introduced in Finland in the 1850's. Since then clay has been the main pipe material though wooden box drains were constructed on organic soils in the first half of this century. Today the share of plastic pipes is 58%, the rest being clay pipes.

Envelope material is always used over the pipes. The dominant envelope material is gravel that fullfills grain size requirements shown in figure 10. Gravel is found in abundance in Finland though its price has recently risen and the availability of good quality gravel has decreased. If gravel is not available it can be substituted by sawdust laid in a 20 - 30 cm layer over the pipe. Pipes prewrapped with polypropylene or coconut fiber material are also available in Finland, but not in common use.

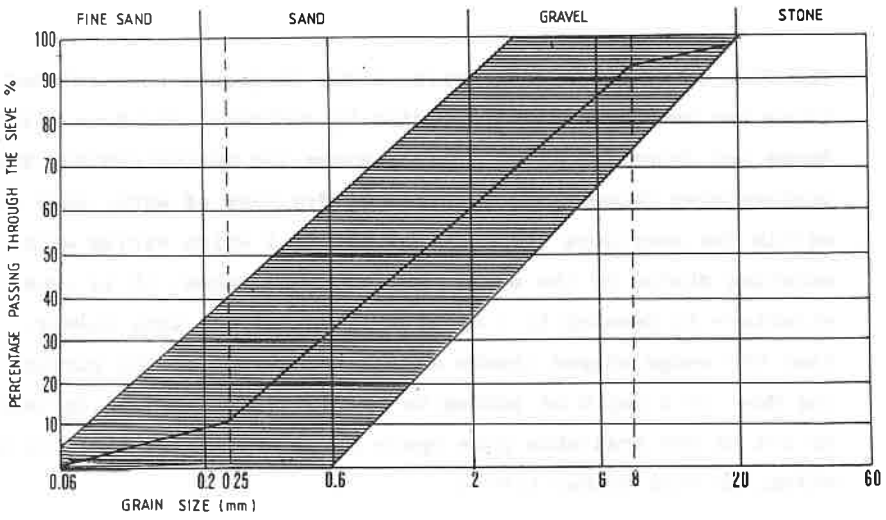

Figure 10. Grain size requirements for gravel for subdrainage systems.