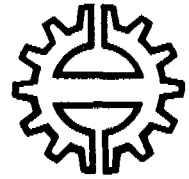


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Development of Rural Water Supply in Finland: Possible Lessons for the Developing World?

- Discussion Paper



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PREFACE AND ACKNOWLEDGEMENTS

The original paper was prepared at Tampere University of Technology (TUT), the Institute of Water and Environmental Engineering. This English version is based on the original in Finnish except for a few modifications. The paper is a by-product of the FINNIDA-supported study on "Role of Cost Recovery in Water Supply in Developing Countries".

The author wishes to thank Dr. M. Wäre (Dr. Tech.) and Prof. M. Viitasaari for their valuable assistance and support. The views of my University colleagues, Messrs. R. Häkkinen and J. Hukka are appreciated. Special thanks go to Mrs. K. Skytta and Mr. T. Skytta for initiating and contributing to the English version. The National Board of Antiquities has kindly supplied a number of photographs included in the report.

Tampere, January 1989

Tapio Katko
Research Officer

Katko, T. 1988

Rural Water Supply Development in Finland: Possible Lessons for the Developing World?

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ABSTRACT

Finland has developed from an agricultural nation into one of the most advanced industrialized countries in the world, perhaps more rapidly than any other Western country. Because this development has happened relatively recently, it is still possible to take advantage of the accumulated experience.

In water supply development in Finland several important factors can be identified. These include, e.g., preference of ground water, water supply for domestic animals, decreasing the workload of women as water-carriers and use of locally available materials such as stone and wood. Stone was used in well construction and wood in wells and lifting devices - and even pipes. Individuals have acted as initiators and managers of water supply. Private small-scale enterprises have manufactured wooden pipes and pumps. Domestic manufacture of plastic pipes began in the late 1950's and by the 1980's Finnish companies are among the leading manufacturers in Europe. Community-managed water cooperatives and stock water companies used to have and still have, an important role in rural water supply.

The experiences of modern developed countries, such as Finland, cannot be directly transferred to the developing world. Besides, there are a number of lessons which the supporting countries have learned from the less developed ones. However, in Finland there is still a wealth of knowledge and experience to be analyzed and utilized. Perhaps the best contribution would be the analysis of the development of community-managed cooperatives and other water associations. It is suggested that in technical and economical factors more attention should be paid to similarities between developed and developing countries to assess possible replicability.

**DEVELOPMENT OF RURAL WATER SUPPLY IN FINLAND
- POSSIBLE LESSONS FOR THE DEVELOPING WORLD?**

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1 INTRODUCTION

"And he looked, and behold a well in the field, and, lo, three flocks of sheep lying there by it; for out of that well they watered the flocks: and the stone upon the well's mouth was great."

Genesis 29:2-3

Rural water supply is one of the main sectors in Finnish development cooperation. The Nordic Countries, in particular, have supported rural water supply programs in Eastern Africa and some countries in Asia. Finland has been involved in this activity for nearly 20 years.

Improving the water supply services in developing countries has proven to be complicated in many respects. Answers to the problems have been sought through developing affordable technical solutions, emphasizing the participation by the beneficiaries in each stage of the project.

The purpose of this study is to roughly analyze the development of rural water supply in Finland, and to determine how this experience could be exploited when seeking solutions to the problems facing the developing countries in the water sector today. Finland has developed into a post-industrial nation perhaps faster than any other western nation. Consequently, a wealth of knowledge and experience is still available on the development of rural water supply systems.

It seems, however, that this wealth of knowledge has not been adequately documented. It is also evident, that this experience has not been adequately exploited in Finnish development assistance in the water sector.

This study is primarily based on literature. The author wishes to thank Dr. Matti Wäre (Dr. Tech.) and Prof. Matti Viitasaari for their valuable assistance and support. Special thanks go to Mrs. Krisse Skytta and Mr. Tauno Skytta for initiating and contributing to the English version which is slightly modified from the original.

2 ECONOMICAL DEVELOPMENT IN FINLAND IN THE TWENTIETH CENTURY

The structure of commerce and industry in Finland has changed dramatically during this century (Fig. 1). The share of agriculture and forestry was still about 80 % in the 1920's and 1930's. The corresponding figure for developing countries today is, in most cases, 70 - 90 %.

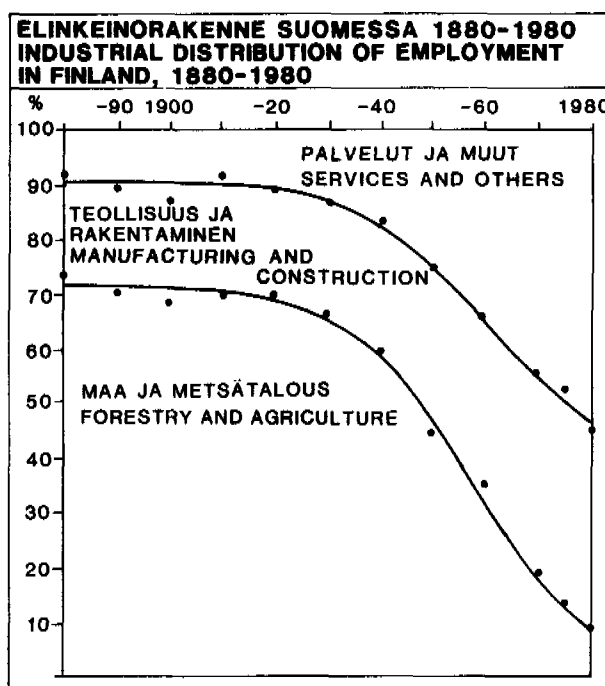


Fig. 1. Industrial distribution of employment in Finland, 1880-1980 (Heikkerö 1987).

Kuva 1. Elinkeinorakenteen kehitys Suomessa vuosina 1880-1980.

According to Hjerppe (1988) the actual per capita gross national product increased 15-fold from 1960 to 1985 in Finland. Private consumption increased 14-fold during the same period. Growth in per capita gross national product has been faster in Finland than in Sweden, the United Kingdom or the United States. (Fig. 2).

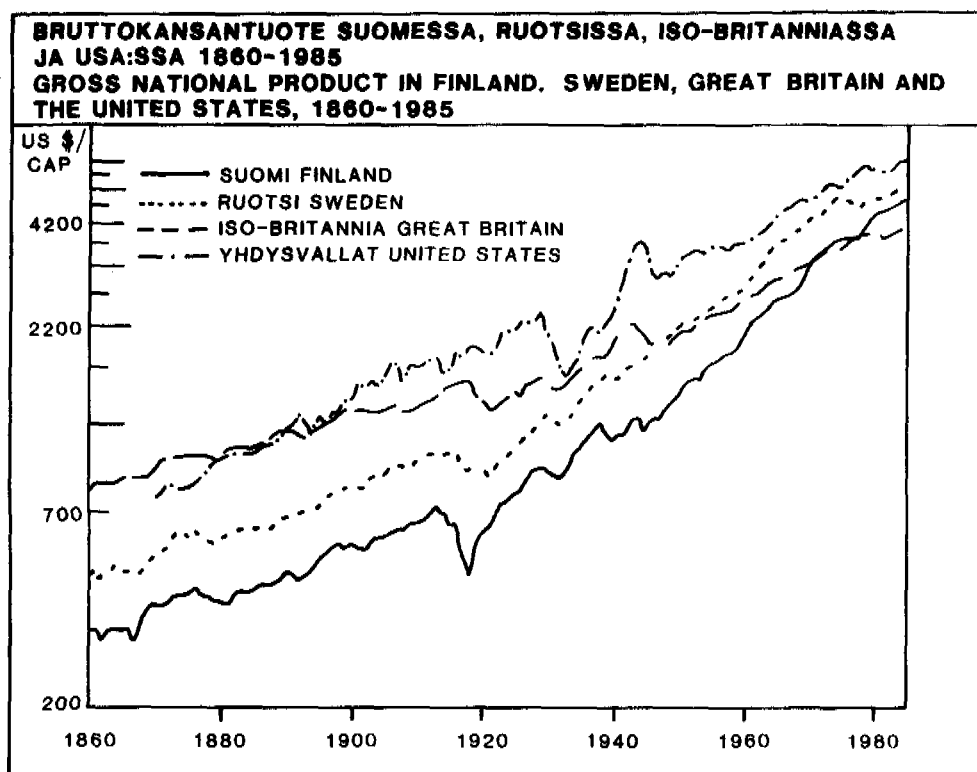


Fig. 2. Per capita gross national product in Finland, Sweden, the United Kingdom and the United States from 1860 to 1985 based on 1970 purchasing power parity (Hjerpe 1988; modified by the author).

Kuva 2. Suomen, Ruotsin, Ison-Britannian ja Yhdysvaltojen bruttokansantuote henkeä kohden vuoden 1970 ostovoimapariteetin 1860-1985 (kirjoittajan muuntama).

In private consumption, the relative share of food products has decreased most sharply, being now only 30 % (Fig. 3). The relative share of clothing rose until the 1950's, but has since gone down. The relative share of recreation and transportation has risen most sharply.

According to Heikkerö (1987), clearing of forests by burning was abandoned about 1920 in Finland. At the same time, fertilizers were being introduced into agriculture (Fig. 4). These changes led to the fact that a balance in the production of food products was achieved in the 1930's. During the war, however, shortages of food products occurred. A balanced situation was again achieved in the 1950's, and after the 1950's there has been overproduction of food products.

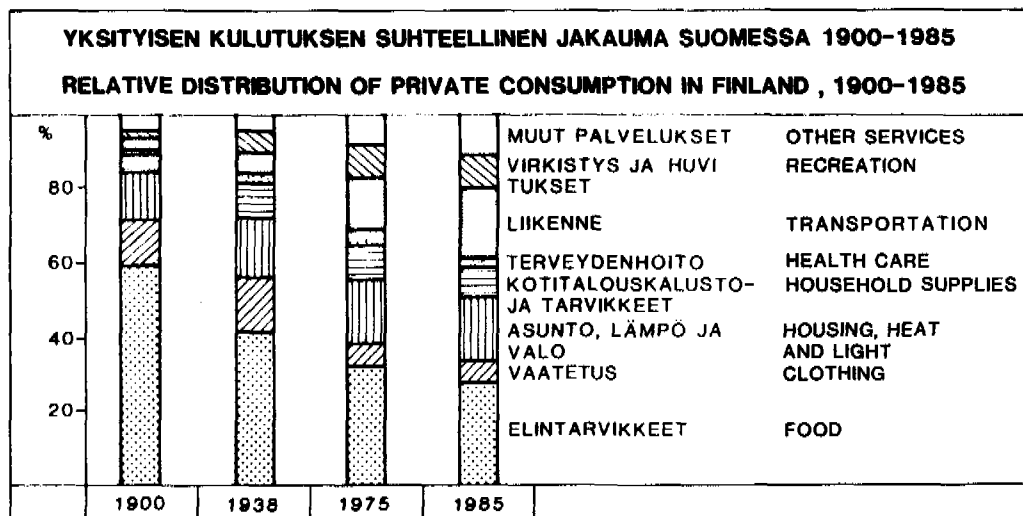


Fig. 3. Relative distribution of private consumption in Finland, 1900-1985 (Seies 1987).

Kuva 3. Yksityisen kulutuksen jakauma Suomessa vuosina 1900-1985.

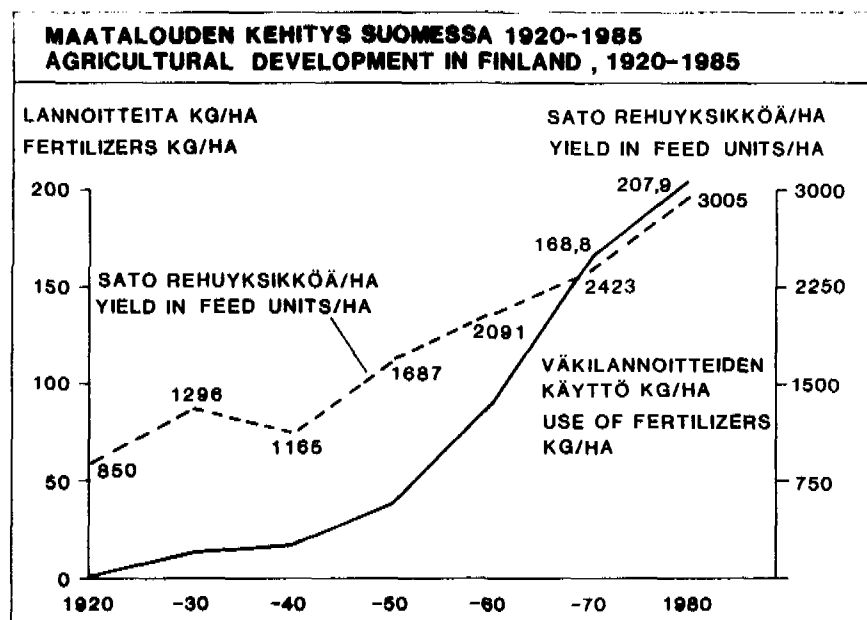


Fig. 4. Development of agricultural production in Finland, 1920-1985: use of fertilizers and average yields per hectare (Heikkerö 1987).

Kuva 4. Suomen maatalouden kehitys vuosina 1920-1985: lannoitteiden käyttö ja hehtaarisadot.

3 WELLS AND LATRINES AS BASIS FOR WATER SUPPLY AND SANITATION

3.1 Early Wells and Latrines

According to Miller (1982), permanent wells were built in Mesopotamia already in 6000 B.C. The first structures having to do with water were irrigation systems. The Bible, particularly the Book of Genesis, contain several descriptions of well building and use. In Finland, remains of wells have been found on pre-historic building sites, and under city streets as well as castles (Appelgren 1901).

In arid regions, the wells have had a determining influence on settlements and the formation of villages. One of the earliest examples of the use of wells in our region can be found in northern Estonia and Saarenmaa, where a village would develop around a good well already in the 13th century (Ränk 1955). In old Vepsian wayside villages each section of the village contributed to the maintenance of the well. Also, each new homestead that was built in the village was given the right to use the well in exchange of certain commitments (Virtanen 1923). Innamaa (1952) mentions a well co-owned by four homesteads in the parish of Kaarina in 1640. The same well was still in use as a community well in the village in the 19th century. According to Numminen (1955), it was common practice in central Ostrobothnia that four to five homesteads operated and maintained a counterpoise lift well for provision of household water. In addition, each homestead had a separate well for its livestock.

According to Sirelius (1919), the latrine is the latest addition to rural culture. Sirelius writes:

"In 1827, in his tale about Kirvu, Halinius mentions tersely: "there are no secret rooms", and in 1802, Holmbom concludes that these are missing in most houses in Liminka. And no wonder, because still in the 17th century they were rare even in parsonages. Johan III had, however, decreed that there should be at least two of these in each parsonage, but in reality, even the conditions in Stockholm were such that a gateway would have to do. In the beginning, when they were being added to parsonages, they were most frequently located in the entrance hall. In homesteads which lacked these facilities, dung-yards in connection with cattle shelters, garbage heaps and the back of the buildings were used."

Vuorela (1975) describes rural sanitation facilities as follows:

"Generally, the yard in front of the cattle shelter which was used for processing firewood, would also serve as a latrine. As a composting measure, dirt was then layered over the evergreen clippings and wood shavings. It was also usual to keep pieces of turf or a sheaf of straw next to the front steps of the house. The turf into which the urine had absorbed was later transferred to the fields as fertilizer, but the sheaf was fed to the cows the next morning."

According to Vuorela (1975) the words used when referring to the latrine were mostly of foreign origin (huusi, hyysi, makki, pikku-kamari, priveetti). This would indicate that the latrine was first introduced in the upper classes. Still in the 1880's information about latrines was spread by soldiers who had been drafted for the reserve. In the 1890's most houses in central Ostrobothnia were equipped with a latrine. It was, however, seldom used, because "who would care to use one" (Relander 1892).

From the preceding paragraph it can be concluded that latrines came into use at a much later date than wells, particularly in rural areas.

3.2 Water Sources

Rural water supply has basically relied on ground water. Four studies that were conducted in the 1930's and in the beginning of the 1940's, indicate that 70-80 % of the households drew their household water from wells, abt. 10 % from springs, and the remaining 10 % used surface water. The location of the well was a determining factor when choosing the site for the house and sauna. In sparsely populated areas, the traveler would make himself a scoop of birch-bark; this he used when he wanted a drink of water. - And lately, the National Board of Roads and Waterways has rehabilitated roadside springs for the convenience of passers-by.

In addition to conventional springs, also so called health springs were used. It was believed that the iron-rich water of these springs had healing power (Paulaharju 1965, Raittila 1987).

Rain water catchments were very rarely used for collecting drinking water in rural areas. In urban areas, however, rain water catchments played an important role before the introduction of water works (Paulaharju 1965).

The simplest well structure consists of a bottomless wooden barrel or cowl that is lowered into the spring. The shaft of the well was traditionally lined with stone or wood. The stone-lined shaft was usually round, and the wooden shaft square. Fig. 5 shows an example of a traditional stone-lined, uncovered spring. In his comprehensive study of wells in Sweden Erixon (1930) pointed out that the materials used in permanent houses were also introduced to well construction. The stone-lined wells were usually shallow, and the wooden wells deeper. To keep rain water out, the outside of the stone-lining in stone wells was protected with a layer of birch-bark (Raittila 1987). The cover of the well was made of wood before concrete covers became available.

Traditionally, the wells were shaft wells that had been dug manually, and they were equipped with a windlass or crank for hoisting the water bucket. In 1951, the breakdown of lining materials was as follows: stone 30 %, concrete 29 %, logs 25 %, board 6 %, earth 5 %, combinations of these, etc. 5 % (Wäre 1952a). Most wells were shaft wells, but also tube wells were constructed as early as in the 1930's (Fig 6).

In the Kokemäki river valley, simple tube wells were already being built in the beginning of this century. A pipe was forced through the layers of clay into depths exceeding tens of meters.



Fig. 5. A traditional stone-lined and uncovered spring at Pyhämaa (Western coast of Finland) in 1928. (Photo: National Board of Antiquities).

Kuva 5. Kivillä verhottu, suojaamaton lähde Pyhämaalla v. 1928. (Valokuva: Museovirasto).



Fig. 6. Tube well construction in Mustasaari-Island close to Oulu in the 1930's (Northwestern Finland). (Photo: National Board of Antiquities).

Kuva 6. Putkikaivon rakentamista Mustasaarella Oulun edustalla 1930-luvulla. (Valokuva: Museovirasto).

The wells are almost artesian, and the water typically reaches up to basement-level (Huru 1988).

From a water consumption point of view, it is important to note that most of the water needed for husbandry was used for watering the cattle. Therefore, the water source was, if possible, built close to the cattle shelters, rather than the house. In the 1930's, the distance to the well on small-scale farms was abt. 50 m (The Committee for Rationalizing Households 1950).

In most cases, one well per household was built. Sometimes one well would serve a couple of families at the most. Because of poor water quality, some villages in western Finland could have a common well, or the villagers would draw their water from a hole in the ice that was kept open by the community (Turunen 1985). Villages in eastern Finland, however, did not have community wells (Virtanen 1934).

In the beginning of the century, the villagers along Kyröjoki river in southern Ostrobothnia used the sauna baths communally. A system was followed in which each villager took his turn to heat the sauna. The family whose turns it was to provide the sauna, was also responsible for providing cold and hot water (Turunen 1985). In eastern Finland, contrary to western parts, a separate well for the sauna was common (Raittila 1987).

3.3 Water Lifting Devices

A variety of methods for hoisting water has been used in different parts of the country. The earliest method might have been a counterpoise lift. All parts were originally made of wood. Fig. 7 shows a counterpoise lift well that has been built next to



Fig. 7. Counterpoise lift well with a trough discharging to sauna in Janakkala (Southern Finland) in the 1880's. (Drawing: Heikel 1887).

Kuva 7. Vinttikaivo ja vesiruuhi kodan ja saunan yhteydessä Janakkalassa 1880-luvulla. (Piirros: Heikel 1887).

the sauna. The water is discharged through a channel or trough to the building (Heikel 1887). The counterpoise lift or shaduf is known to have been used in ancient Egypt as early as the third millennium B.C. (Drower 1956). Fig. 8 shows a counterpoise lift well which is equipped with a trough discharging to the cow shed. Along the Ostrobothnian rivers counterpoise lifts were also used for hoisting surface water (Turunen 1985).

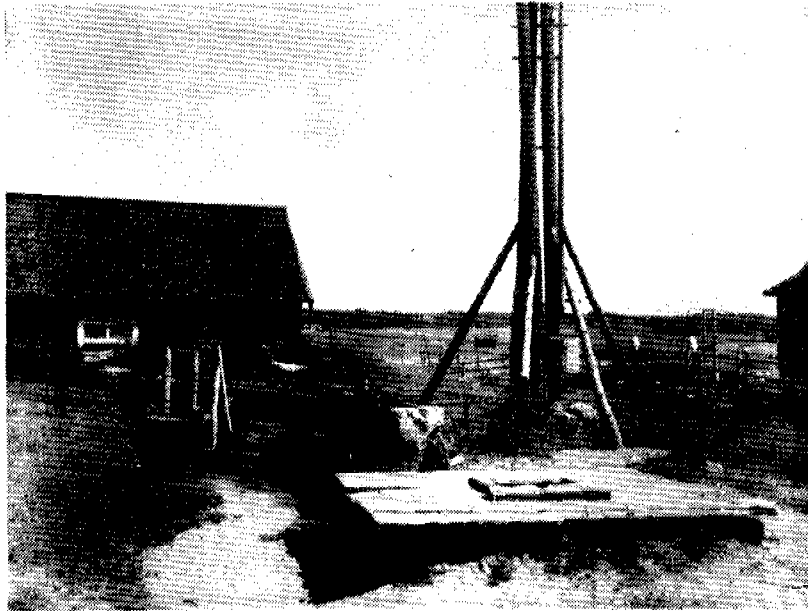


Fig. 8. Counterpoise lift well in Alahärmä (Western Finland) in 1930. The well is equipped with a trough discharging to cow sheds. (Photo: National Board of Antiquities).

Kuva 8. Vinttikaivo Alahärmässä v. 1930. Kaivon yhteyteen on rakennettu navettaan johtava vesikouru. (Valokuva: Museovirasto).

Fig. 9 shows a well with windlass, which is equipped with a small roof to protect the bucket. Much more common were wells with a double-sloping roof that covered the entire well (Fig. 10). One section of one side of the roof was hinged and served as cover. The well could still be equipped with a detachable cover that rested on the "collar" of the well.

Windlass wells have been used, and are still in use particularly in northern Finland, where wells are deeper than in other parts of the country (Wäre 1952b). In the 1930's in Estonia different types of windlass wells were most common, and counterpoise lift wells were used when the water table was high (Ränk 1937).



Fig. 9. Well with windlass and bucket in Salla (Northern Finland) in the 1940's. (Photo: National Board of Antiquities).

Kuva 9. Vinssi- eli veivikaivo Sallassa 1940-luvulla. (Valokuva: Museovirasto).

In 1950-51, the Engineering Division of the National Board of Agriculture conducted a survey of rural water sources. The most common water lifting devices were: bucket with rod, handpump and windlass. Only about 7 % of the rural households had piped water (Fig. 11). Handpumps accounted for 21 % of the water lifting devices.

In 1945, the majority, or 70 % of all the Danish farms that had their own water supply systems, were equipped with handpumps (Christensen 1951).

The oldest handpumps were made of wood (Fig. 12). They were installed either on the cover of the well, or were operated from the cattle shelter. The wooden pumps were made of spruce, as it withstands water better than pine. The wooden pumps are said to have lasted for some tens of years. Handpumps became more popular when the cast iron versions became available.

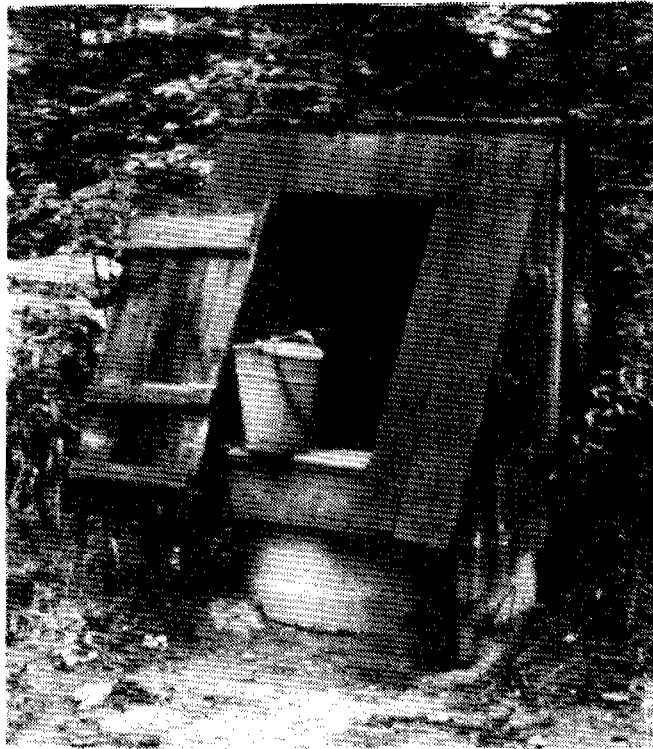


Fig. 10. Well with windlass covered by a double-sloping roof still commonly in use in the rural areas of Finland. (Photo: T. Katko).

Kuva 10. Kaksilappeisella katoksella suojattu vinssikaivo, jota käytetään vielä yleisesti Suomen maaseudulla. (Valokuva: T. Katko).

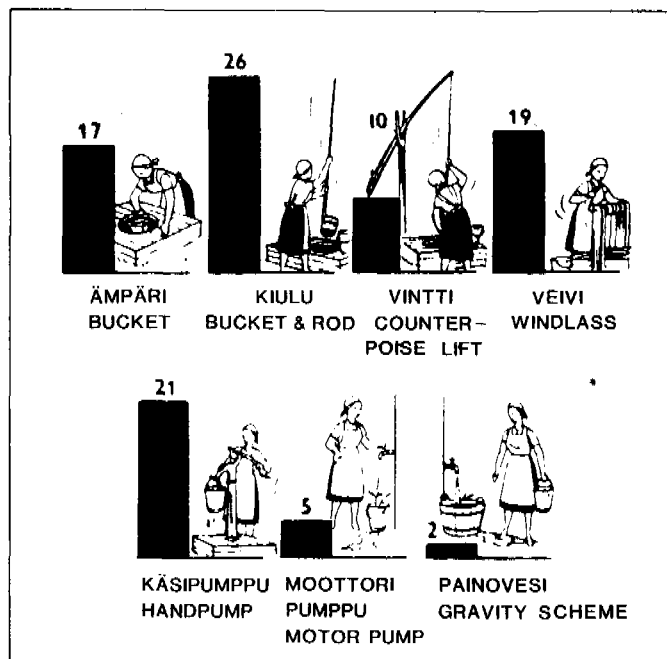


Fig 11. Distribution of water lifting devices in rural areas of Finland, 1950-1951 (Wäre 1952a, modified by the author).

Kuva 11. Vedennostolaitteiden jakautuma Suomen maaseudulla vuosina 1950-1951 (kirjoittajan muuntama).



Fig. 12. Well equipped with a wooden handpump in Mouhijärvi (Western Finland) in 1933. (Photo: National Board of Antiquities).

Kuva 12. Puisella käsipumpulla varustettu kaivo Mouhijärvellä v. 1933. (Valokuva: Museovirasto).

There were presumably three manufacturers of cast-iron handpumps in Finland in the 1930's. The first cast-iron pumps were so called suction pumps. The manufacture of cast-iron pressure handpumps started in the late 1950's in Finland. To date, about 160 000 such handpumps have been manufactured. Fig. 13 shows a NIRA-handpump, which is manufactured by Vammalan Konepaja Ltd. The NIRA-pump has about 80 % of the market in pressure handpumps. The demand for handpumps was at a peak between the beginning of the 1960's and the middle of the 1970's. Today, some 2 000 NIRA-pumps are sold per year in Finland (Suuriniemi 1988). In the last few years, the handpumps have found a new market in recreational, second homes. Since the mid 1970's work has been underway to develop a version of the NIRA-handpump that would be suitable for conditions in the developing countries.

3.4 Water Quality

Many myths about water quality and its effect on health have been handed down in folklore. Before 1900, it was believed that health springs had healing powers, and it was also generally believed that frogs could purify well water. (Paulaharju 1922, Raittila 1987).

Turpeinen (1979a) had surveyed the development of mortality in Finland. Infant mortality which is highly dependant on hygienic conditions was very high up to the latter part of the 1800's (Fig. 14). Breast-feeding became more general toward the

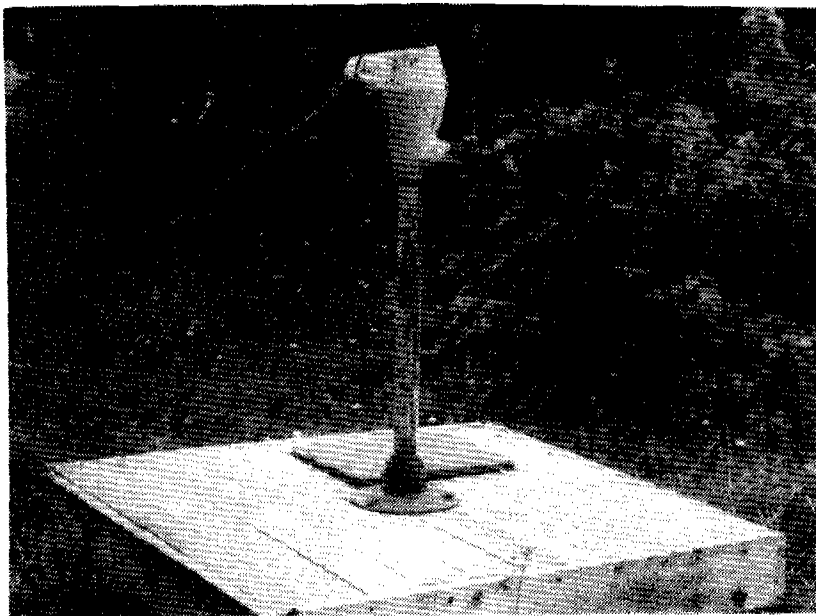


Fig. 13. NIRA-handpump with 130 000 units manufactured since the 1950's. (Photo: T. Katko).

Kuva 13. NIRA-käsipumppu, jota on valmistettu noin 130 000 kpl 1950-luvulta lähtien. (Valokuva: T. Katko).

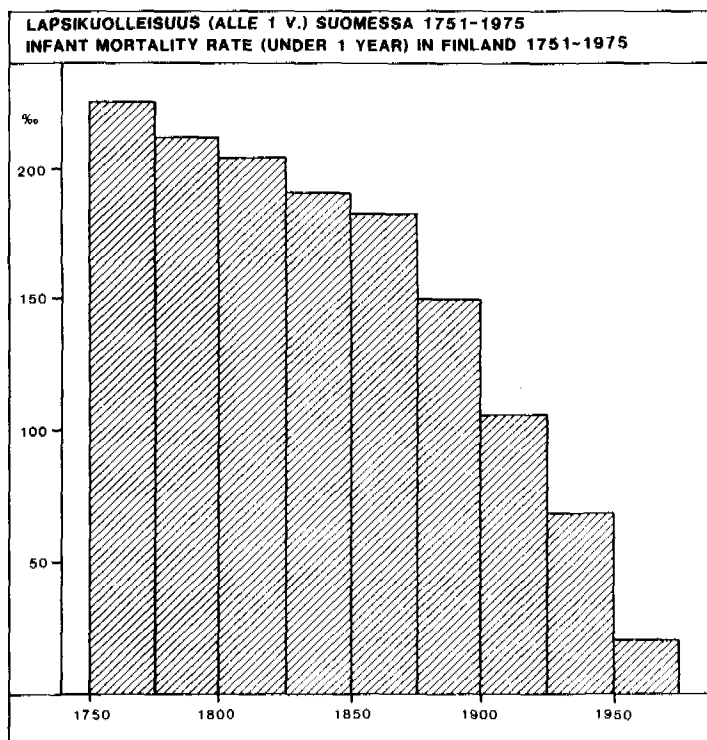


Fig. 14. Infant mortality rates for children under one year in Finland, 1751-1975 (Turpeinen 1979a).

Kuva 14. Alle yksivuotisten lasten kuolleisuus Suomessa vuosina 1751-1975.

end of the century due to promotional campaigns. Thus infant mortality decreased most in areas where breast-feeding was not commonly practised in the mid-eighteenth century (Turpeinen 1979a). At the end of the Finnish summer, in August, particularly high mortality rates were found in places along rivers in Ostrobothnia (Turpeinen 1979b). There is reason to believe that this was to a large extent due to polluted water.

The materials used for the cover and lining of the well have also had an effect on water quality. According to many sources, the cover structures of the wells were still in the 1920's and 1930's often in need of improvements. In the 1930's, open wooden wells were most common in Estonia (Ränk 1937). In Kisii in Western Kenya, for example, people use wells that, instead of a cover, only have two boards across the opening with a rope and a bucket tied to them. A simple cover structure would improve the quality and safety of the water of such a well significantly (Nyangeri 1986).

In 1958, the Engineering Division of the National Board of Agriculture conducted a study on the quality of household water and water sources in rural Finland. This is the only study covering the whole country so far. Samples were taken from 2764 different locations. School districts, with the number of pupils in the two lowest grades of primary school corresponding to 1000 rural inhabitants, were selected (50 pupils/1000 inhabitants). For every 50 pupils, a water sample was taken. The median depth of the wells was: in Lapland ca. 4.8m, on the Aland Islands ca. 2.6 m, and in the rest of the country ca. 3.2 m - 3.8 m. The water level in the wells was 2.1 m below ground level, calculated as an average for the whole country. Only 10 % of the wells had water levels below 5 m from ground level. In about 55 % of the wells, the iron level of the groundwater was over 0.3 mg/l and in 25 % the corresponding figure was over 1.0 mg/l. About 10 % of the groundwater samples showed magnesium levels in excess of 0.1 mg/l (Wäre 1961a).

The Committee for Rationalizing Households (1950), referring to some studies on water hygiene, concluded that only a small number of our wells met the standards set for safe well water. The use of surface water was considered risky in all circumstances by the committee. There had, for example, been typhus epidemics in communities along larger rivers and in industrial and residential areas during the years 1924-43 (Fig. 15). Wäre (1988) mentioned that after the Second World War those Karelian people resettled in Ostrobothnia became often infected with typhus. The local people, however, seemed to be immune to typhus.

According to Rausti (1954) more than 80 % of the deaths caused by water-borne diseases in 1941-1950 occurred in rural areas. Rausti also concluded that the incidence of water-borne diseases went down with the increase in piped water. However, still at the beginning of the 1950's, mortality rates were higher in Finland than in the rest of western Europe (Table 1).

In the on-going water supply development project of dispersed rural areas it has been found out that almost all of the rural wells

have some constructional weaknesses causing risk of surface water infiltration (National Board of Waters and Environment 1988).



Fig. 15. Typhus epidemics in Finland, 1924-1943. Cases with more than 1 % of the population of the municipality infected are marked with a cross. The mortality rate due to typhus has been about 20 % (Wäre 1952a).

Kuva 15. Lavantautiepidemiat Suomessa 1924-1943. Tapaukset, joissa yli sadasosa kunnan väestöstä on sairastunut, on merkitty risteillä. Kuolleisuus veden välityksellä leviävään lavantautiin on ollut noin 20 %.

From the points of water use and hygiene the phenomenon of sauna in Finland is a special case. For instance, in 1980 there were just over one million saunas in permanent houses in Finland compared to the total population of under 5 million. There were also about 220 000 summer cottages with a sauna (Central Statistical Office of Finland 1988). The sauna tradition which is hundreds if not thousands of years old, has most probably improved the hygienic conditions.

Table 1.

Mortality from typhus and paratyphus in some European countries, 1930-1950 (Rausti 1954). The Second World War increased mortality in Finland more than in the other countries mentioned (additional note by the author).

Taulukko 1.

Lavantautiin (typhus abdominalis) ja pikkulavantautiin (paratyphus) kuolleiden henkilöiden määrä eräissä Euroopan maissa vuosina 1930-1950. Toinen maailmansota lisäsi kuolleisuutta Suomessa enemmän kuin vertailumaissa (kirjoittajan lisäys).

Maa Country	Ajanjakso Period	Kuolleisuus/vuosi (milj. as.) Mortality rate/annum (millions)
Englanti ja Wales England and Wales	1941...1950	1.5
Ruotsi Sweden	1941...1947	4.0
Sveitsi Switzerland	1941...1949	5.4
Suomi Finland	1931...1940	25.0
Suomi Finland	1941...1950	43.0

3.5 Water Carrying and Transportation Methods

According to research by Palosuo (1941), water was most often carried in one bucket or cowl when the distance was less than 100 m. When the distance was 200 m, water was carried in two buckets. Water was also carried using a shoulder pole. The pole was slipped through the handles of a cowl, for example, and two people were needed to carry it (Fig. 16). The yoke for carrying water originated in south-western Finland (Fig. 17). The Work Efficiency Institute (1945) was involved in developing a similar so called "ämmänlänki", or "woman's double yoke". The wooden frame of this yoke was split in two and connected with a belt of webbing. The belts rested on the shoulders of the carrier (Fig. 18). In the winter, a sled was often used for hauling water. Hand-pulled carts became more common with the development of farming, but these carts were not specifically acquired for hauling water.



Fig. 16. Carrying of water using shoulder pole and wooden container in Kurikka (Western coast of Finland) in the 1930's. (Photo: National Board of Antiquities).

Kuva 16. Veden kantoa korennolla Kurikassa vuonna 1925. (Valokuva: Museovirasto).

Gebhard (1944) researched the different methods of carrying water, the stress they caused, and their effectivity. With the woman's double yoke the efficiency could be raised by 80 %; with the hand-pulled cart, by abt. 200 %, and, with a combination of sled and cowl, by abt. 230 %, when compared to hand-carrying of one bucket of water at a time. By developing the carrying methods, the stress of fetching water could be alleviated.



Fig. 17. Yoke for carrying water in Rymättylä (Southwestern coast of Finland) in 1938. (Photo: National Board of Antiquities).

Kuva 17. Veden kanton käytetty olkapuu eli kahlu Rymättylässä vuonna 1938. (Valokuva: Museovirasto).

Wäre (1952a) estimated that in 1952 Finnish women walked the distance to the moon every day in their efforts to fetch water (Fig. 19). However, as far as we know, water has not been carried on the head in Finland, as is the tradition particularly in Africa.

In rural areas, horses were used for hauling water, mainly temporarily, e.g. when the wells dried up. In the cities, however, horses were used more regularly for distributing household water before the construction of piped water supply systems. This transportation of water was the task of men, contrary to hand-carrying of water, which was the task of women.

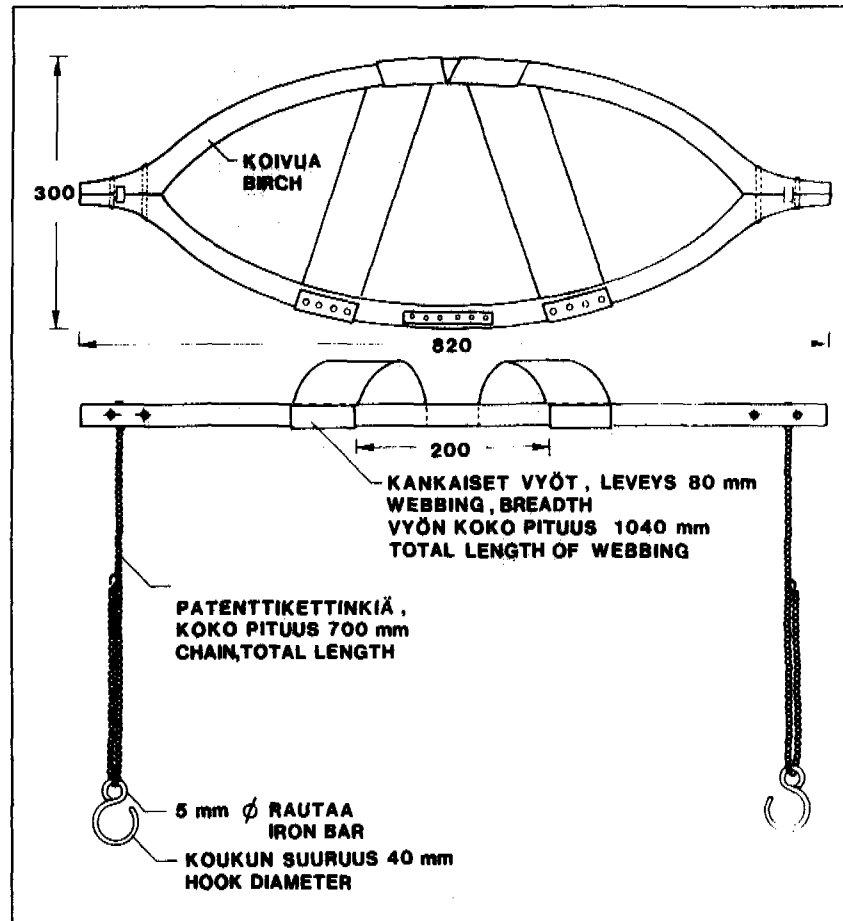


Fig. 18. Water carrying equipment called "Woman's double yoke" developed for water carrying by the Work Efficiency Institute (1945).

Kuva 18. Työtehoseuran kehittämät "ämmänlänget" veden kantamisen tehostamiseksi.



Fig. 19. In 1952 Finnish women walked altogether 400 000 km every day equalling the distance from earth to the moon, in carrying water to cow sheds and kitchens (Wäre 1952a).

Kuva 19. Vuonna 1952 Suomen naiset kulkivat joka päivä yhteensä 400 000 km eli matkan maasta kuuhun kantaessaan kahdella ämpärillä vettä navettaan ja keittiöön.

3.6 Well Siting

According to old tradition, the location of the well was determined through browsing or witching, using a twig of willow. According to Vuorela (1975) this originally Central European custom reached Finland only in the beginning of this century (Wäre 1953). In Germany this custom can be traced to the 11th century, but the first mention in literature dates back to the 16th century. Information about well siting methods make up the largest part of the material relating to water in the collections of the Finnish Literary Society and the Dictionary Foundation. Wells have also been sited with the help of a bottle or glass filled with water or alcohol (Raittila 1987).

According to a study conducted in 1950, almost 80 % of our wells were sited with the help of witchers. In 1949 and 1950, the Water Engineering Department of the National Board of Agriculture conducted an experiment to which 42 well-recognized witchers were invited, and were given the task to locate the water veins in the Botanical Gardens of Helsinki University (Wäre 1953). The results, all of which are different, are presented in Fig. 20. The belief in water veins and witchers still seems to be strong, however, and this belief has even spread to the developing world.

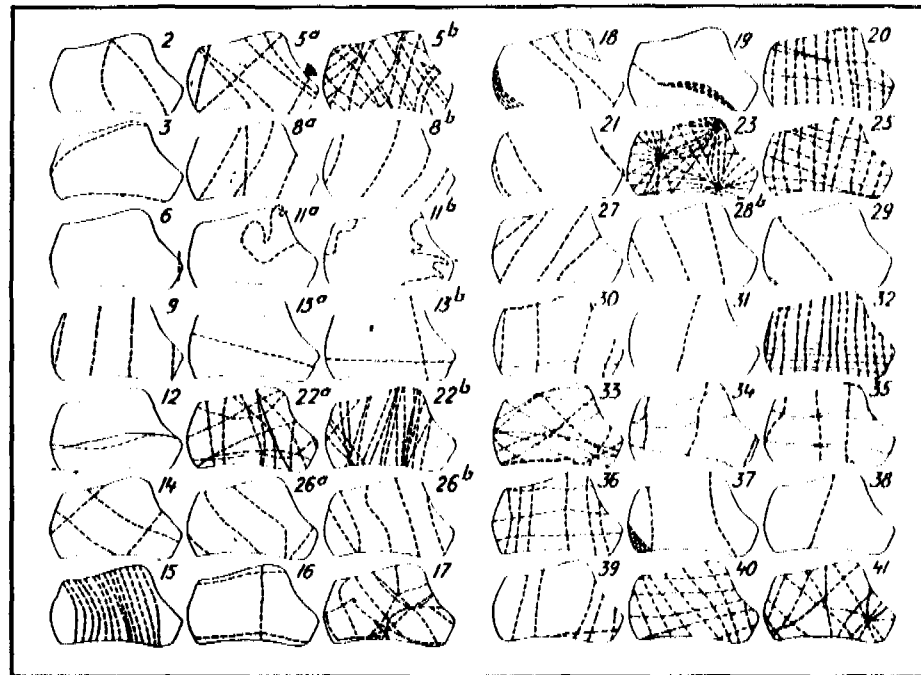


Fig. 20. Water veins and radiation lines located in the same area by witchers. There were as many different "maps of waterveins" as witchers. Experiments nos 5, 8, 11, 13 and 26 were performed twice. The second set of experiments was arranged so that the first set of results could not be taken advantage of. The results of the second experiments were totally different from the first ones (Wäre 1953).

Kuva 20. Varpu-, kello- ja näkijämiesten samalta alueelta löytämiä vesisuonia ja säteilylinjoja. Koehenkilöt (5), (8), (11), (13) ja (26) suorittivat kokeen kahdesti. Vesisuonet tulivat uusintakokeissa eri paikkoihin, kun koe järjestettiin niin huolellisesti, ettei kukaan kaivonkatsojista ollut tietoinen edellisen kerran tuloksista.

Various maps and plans show the locations of the water source in relation to the buildings. According to Raittila (1987), the location of the well is recorded with more certainty the older the documents are. It can therefore be concluded that either the provision of water was particularly important in old-time households, or the water lifting devices stood out as particularly visible features of the landscape.

4 DEVELOPMENT OF WATER SUPPLY NETWORKS

The development of public water supply systems in Finnish cities began in the 1870s. The water supply schemes in rural areas developed much later and slower, because water pipes were in short supply, and they were expensive.

4.1 Wooden Pipes

In the first stages of rural water supply schemes, wooden pipes, mostly of hollowed pine, were used. In 1951, the Engineering Department of the National Board of Agriculture conducted a survey of the use of wooden pipes in 33 water works mostly in southern Ostrobothnia. The oldest wooden network was found in Ilmajoki, and it dated back to 1872. Wooden pipes were generally used in gravity schemes (Fig. 11). The highest recommended water pressure was 20 m according to the survey (Peräkylä 1952).

Originally, the wooden pipes were hollowed by using a hand drill (Fig. 21), but later machine-drills were introduced. The diameter of the pipe did not, in most cases, exceed 100 cm. No actual couplings were used to connect the pipes other than a metal hoop that was placed around the joint. The pipes were manufactured by private entrepreneurs. In Ostrobothnia for example, there were tens of such enterprises. Fig. 22 shows machine-boring of wooden pipes in the late 1950's. An example given by Peräkylä (1954), revealed that 200 m of wooden pipe was bored in 8 hours using a machine-drill with an electric drive. This included the preparation of the pipe ends for connection. Two men were needed for the job. The workmen who manufactured wooden pipes also manufactured wooden handpumps (Raittila 1987).

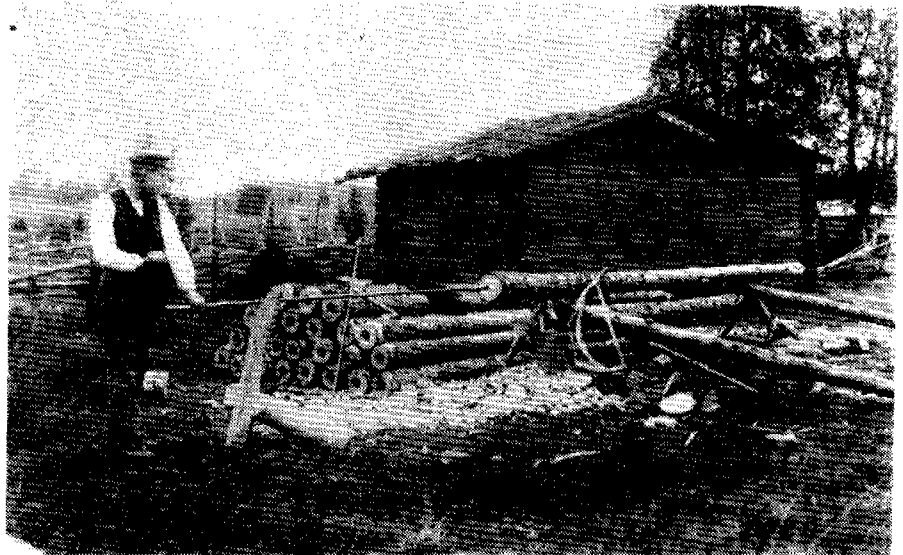


Fig. 21. Hand-boring of wooden pipes in Teisko (Central Finland) in 1920. The logs were 6 meters long and the boring rod was over 3 meters long. (Photo: National Board of Antiquities).

Kuva 21. Puuputkien käsikairausta Teiskossa vuonna 1920. Tuikit olivat 6-metrisiä ja kaira yli 3-metrinen. (Valokuva: Museovirasto).



Fig. 22. Machine-boring of wooden pipes in Ilmajoki (Western part of Finland) in the late 1950's. (Photo: M. Viitasaari).

Kuva 22. Puuputkien koneellista kairausta Ilmajoella 1950-luvun loppupuolella. (Valokuva: M. Viitasaari).

4.2 Founding of Water Cooperatives and Water Associations

On the initiative of the water consumers themselves, water cooperatives and associations for organizing public water supply schemes were established in Ostrobothnia. One of the first of such water associations was established in Toholampi in central Ostrobothnia in 1906 (Vikman 1985). It is told that the idea to build pressure networks came all the way from North America. Other early water cooperatives and associations were established in Ilmajoki, Karijoki, Kauhajoki, Kurikka, Saarijärvi, Teuva and Ylivieska (Peräkylä 1952). In most cases, the water was tapped from springs. The water was then conducted from the source by gravity to the distribution area through a wooden network. The relatively flat landscape of Ostrobothnia was well suited for this type of schemes.

It only took one - or a few - active individuals to found a water cooperative or association. Women, who in most cases were responsible for the provision of water, were also often among the founding members of a new cooperative. As the new water supply schemes became more firmly established, the role of women diminished. At the same time, the role of men became more important, particularly in questions relating to technical matters. About 30 actual water cooperatives had been legally registered by 1950. In addition to these, there were other types of water associations (The Committee for Rationalizing Households 1950).

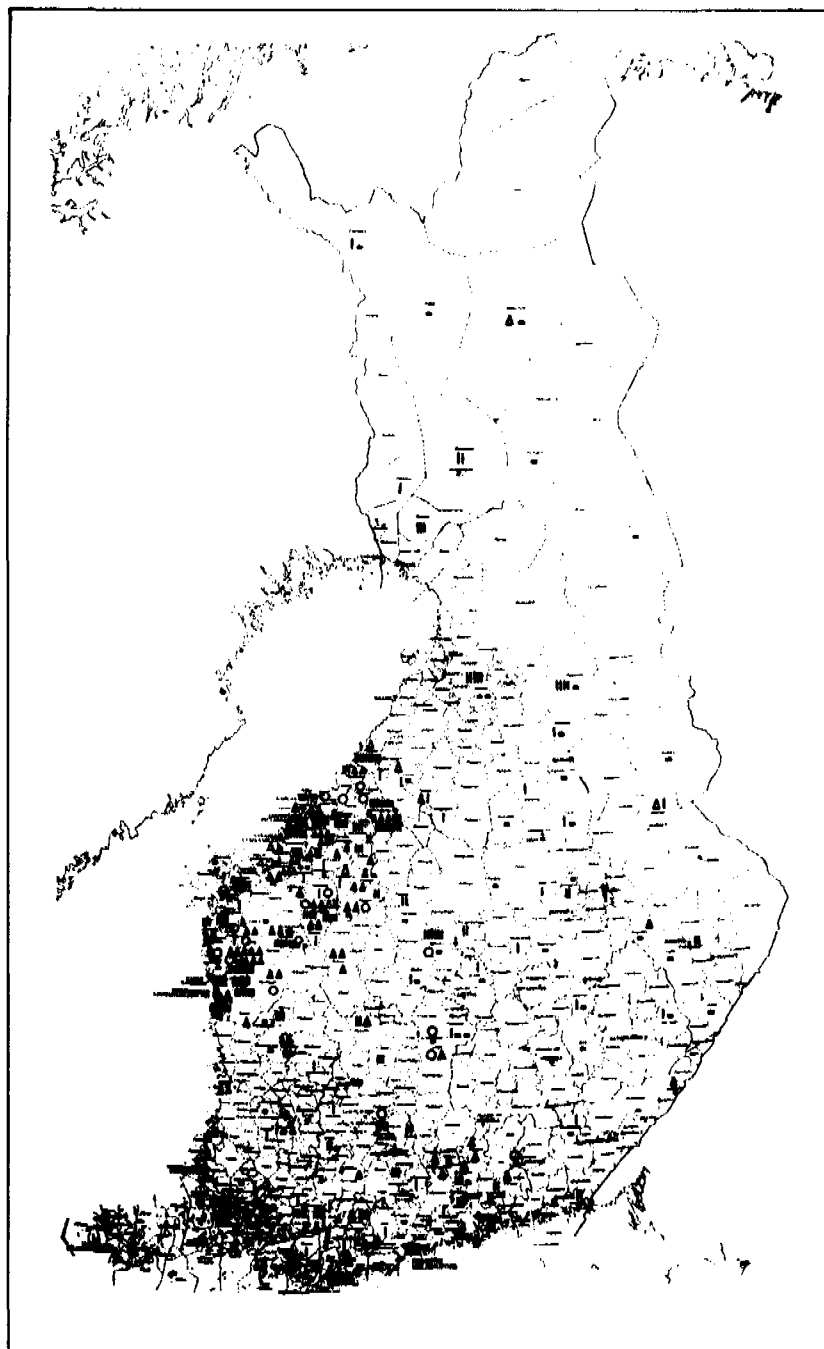
According to a study in 1950 by the National Board of Agriculture, there were 389 public piped water supply systems and 75 sewerage systems in the 483 rural communities in Finland. The Vaasa region (western coast) had the highest number of public systems. Public piped schemes were also common around the glacio-fluvial formations of Salpausselkä and Suomenselkä (Fig. 23.)

According to the above mentioned study, 352 communities had no public water supply network, and 418 lacked a public sewerage system. Approx. 2/3 of the schemes served less than 20 households, i.e. most of them were very small-scale (Table 2).

Table 2. Construction of shared piped water supply in Finnish rural communities by 1950 (Wäre 1951).

Taulukko 2. Yhteisten vesijohtojen rakentaminen Suomen maalaiskunnissa vuoteen 1950 mennessä.

Valmistumisaika Completion year	Vesijohtojen lukumäärä No. of piped water supply systems			Yhteensä Total
	3 - 20	21 - 100	101 -	
- 1900	3			3
1901 - 1910	9	2		11
1911 - 1920	8	1		9
1921 - 1930	23	9	1	33
1931 - 1935	12	2	3	17
	} 53		} 4	
1936 - 1940	41	11	1	53
1941 - 1945	9	4	-	13
1946	6	2	1	9
	} 131		} 52	
1947	7	2	2	11
1948	32	9	2	43
1949	47	14	5	66
(1950)	30	21	6	57
	} 122		} 16	
	} 48		} 16	
	} 199			
Yhteensä Total	281	86	22	389
Ei tietoa valmistusajankohdasta Year of completion not known				
	54	9	1	64



- | | |
|--|--|
| <ul style="list-style-type: none"> □ vesijohtoyhtymä, 3-20 taloutta
water supply company, serving 3-20 houses ▲ vesijohtoyhtymä, 21-100 taloutta
water supply company, serving 21-100 houses | <ul style="list-style-type: none"> ○ vesijohtoyhtymä, yli 100 taloutta
water supply company, serving over 100 houses — viemärijohtoyhtymä
sewerage company |
|--|--|

Fig. 23. Location of public water supply pipes and sewers in rural communities in Finland in 1950. The Vaasa region on the western coast of Finland had the highest number of common pipelines (Wäre 1951).

Kuva 23. Yhteisten vesi- ja viemärijohtojen sijainti Suomen maalaiskunnissa vuonna 1950. Eniten yhteisiä johtoja oli Vaasan läänissä.

4.3 Development of Water Supply Schemes for Husbandry

In 1948 the government appointed a committee to work out a plan to rationalize the households, with particular focus on small-scale farms. This, so called, "Women's Committee" (all 9 members were women) completed their report in 1950. The report concluded that piped water and sewers were of importance for the following reasons, among other things (The Committee for Rationalizing Households 1950):

- * In husbandry hand-carried water, which often does not meet the drinking water needs of the cows results in lower milk production.
- * The cost of hand-carried or transported water is many times higher than the cost of machine pumped or gravity flow water.
- * Hand-carrying of water is one of the most strenuous tasks of women, especially on small-scale farms.
- * Hand-washing of laundry, particularly in winter, is one of the hardest chores of women; it also presents a serious health hazard.
- * Piped water can also be used for irrigation of gardens, specialized crops, and pastures.
- * Shortage of water hampers fire fighting efforts.

The Committee referred to three separate studies conducted on women's work-hours on farms. The average work-hours for women were 12 to 16 hours on week-days, and 9 to 11 hours on Sundays.

According to the Committee, the most significant reason for the primitive state of water supply and sewer systems was the low esteem accredited to women's work. Other reasons given were, among others:

- * The health aspects linked to water had not been fully understood.
- * Water and sewerlines are expensive.
- * Technical know-how is inadequate.

The above mentioned issues have received much attention in the development of rural water supplies in developing countries in recent years.

Husbandry has held a central position in the development of rural water supplies. Fig. 24 presents the statistical data for piped water to the dwelling and the cow shed; sewer from the dwelling; and electrification of small-scale farms, for the years 1941, 1950, 1959 and 1969. The data reveal that electricity was introduced before piped water; cow sheds were provided with piped water before dwellings got sewers; dwellings were provided with sewers before piped water.

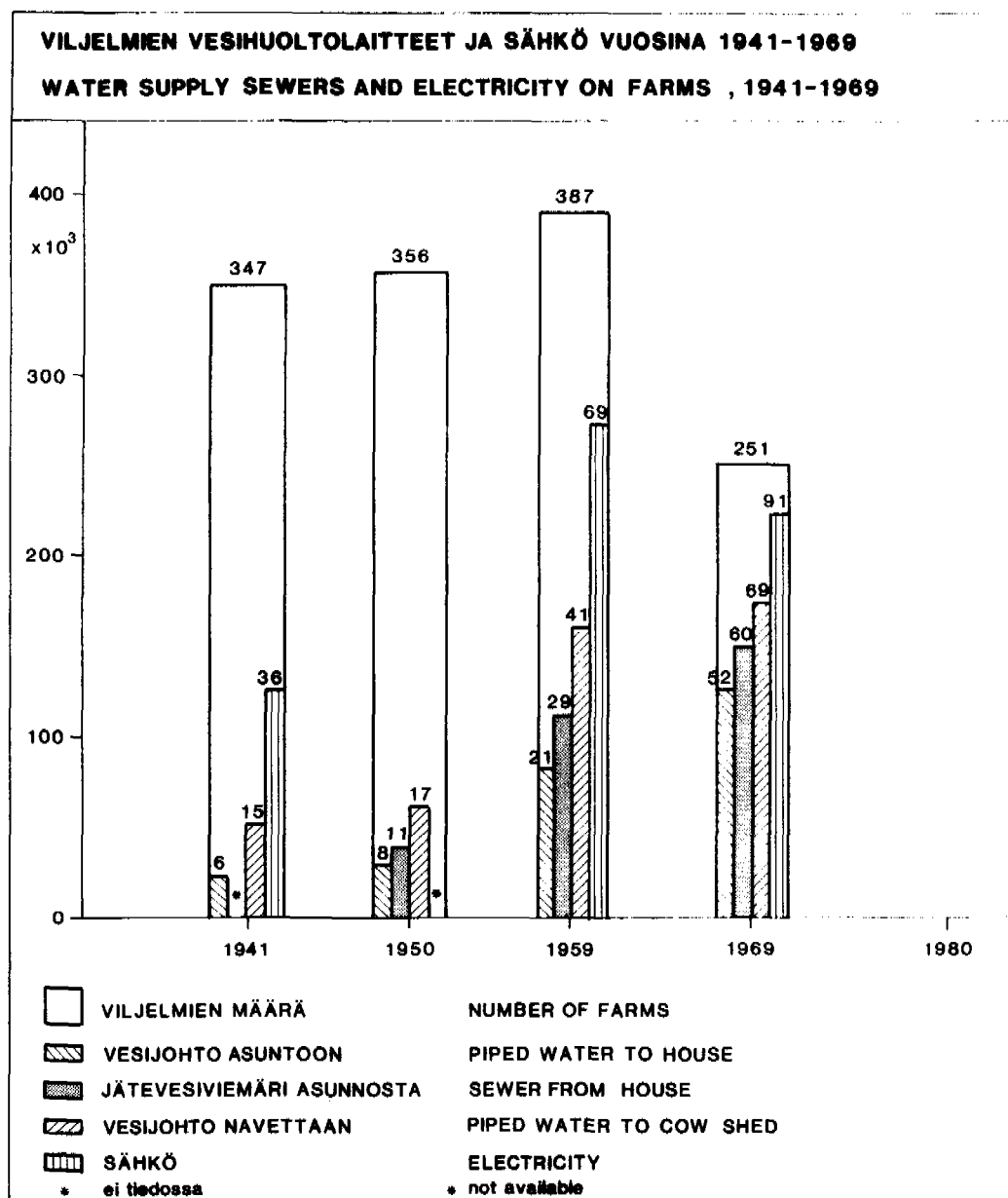


Fig. 24. Prevalence of piped water, sewers and electricity in farm houses, 1941-1969 (Census of Agriculture, 1941, 1950, 1959, 1969; compiled by the author).

Kuva 24. Vesijohtojen, viemäreiden ja sähkön yleistymisen viljelmillä vuosina 1941-1969 (kirjoittajan kokoama).

The water supply schemes for husbandry underwent a vigorous development after WW II, i.e. in the 1950's and 1960's. In the electrification of rural areas, two larger booms can be distinguished: the 1920's, and the years of reconstruction after WW II. This boom lasted until the 1960's (Pylkkänen 1985). With the electrification of rural areas came the electric pumps for the wells and the possibility to provide the dwelling and the cow shed with piped water. According to a survey of farms in 1978, 73 % of the farmhouses had piped water, and 75 % had a sewer. About 20 % of the farms were connected to public water supply systems (Ministry of Agriculture and Forestry 1983).

Fig. 25 shows the regional distribution of farms with piped water in 1950. In relative terms, the availability of piped water was highest in Ostrobothnia, which also was the region with the highest number of public water schemes (Fig. 23). The iron content of the household water in some areas was, however, too high, or was polluted. Consequently, the increase in piped water does not give a fully accurate picture of the overall development of water supply services in rural Finland (Wäre 1961a).

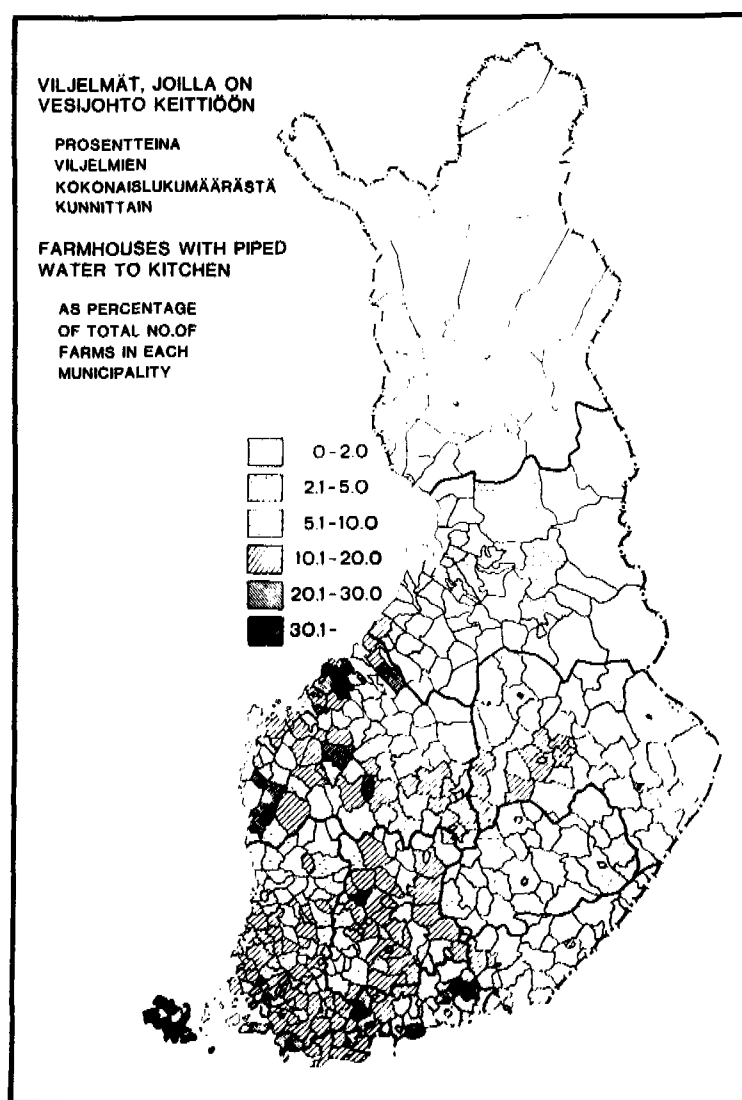


Fig 25. Farms with piped water to house in 1950 (Wäre 1952a).

Kuva 25. Viljelmät, joilla oli vesijohto asuntoon vuonna 1950.

4.4 Development of Residential Water Services

Table 3 illustrates the increase in water supply and electricity services for all dwelling units in Finland based on population censuses. Hot water has been the least common, and the sewer the most common water related service. In 1985, however, the corresponding figure had jumped to 90 %. The electrification process has been much faster than the introduction of water services.

Table 3. Water supply, sewers and electricity in dwelling units (cities and rural areas combined) in Finland according to population census 1950, 1960, 1970, 1980 and 1985. (Peräkylä 1967; Central Statistical Office of Finland, 1952, 1962, 1973, 1982, 1987; compiled by the author).

Taulukko 3. Asuinhuoneistojen vesihuoltolaitteet ja sähkövalo Suomessa väestölaskennan mukaan (kaupungit ja maalaiskunnat yhteensä) vuosina 1950, 1960, 1970, 1980 ja 1985 (kirjoittajan kokoama).

Vuosi Year	Asuin- huoneistot yht.	Huoneistoissa Dwelling units with					
		Total no. of dwelling units	Lämmin vesi Hot water %	Vesikäymälä Water closet %	Vesijohto Piped water %	Viemäri Sewer %	Sähkö Elec- tricity %
1950	995 662		7	17	25	27	77
1960	1 211 000		24	35	47	52	89
1970	1 463 221		50	61	67	74	96
1980	1 838 058		74	79	84	85	E.T.
1985	2 020 139		E.T.	91	94	96	99 ¹⁾

E.T. ei tiedossa (not known)

1) kirjoittajan arvio (author's estimate)

4.5 Development of Pipe Materials

The water pipes in urban areas were made of cast-iron, steel and copper. In rural areas wooden pipes were predominant. The production of copper pipes started in 1941 in Finland (Anon 1961). In 1951 the domestic centrifugal production of cast iron pipes satisfied the demand of the domestic market (Anon 1961). The centrifugal casting technique used in the manufacture of the pipes had been invented in the 1920's (Strandholm 1961). The production of plastic pipes started in 1954 in Finland (Lühr 1961). Plastic pipes had, however, been introduced a few years earlier. Asbestos pipes have been manufactured since 1961.

The total length of water supply pipelines has increased dractically since the 1960's (Fig. 26). Cast-iron and steel pipes were dominant in urban water supply networks up to the 1970's (Fig. 27). The share of asbestos pipes has never been more than a

few per cent. In rural areas, the wooden pipes started being replaced by plastic pipes, when these became available on the market. Nowadays, the Finnish plastic pipe industry is one of the leaders on the European market (Anon 1988b).

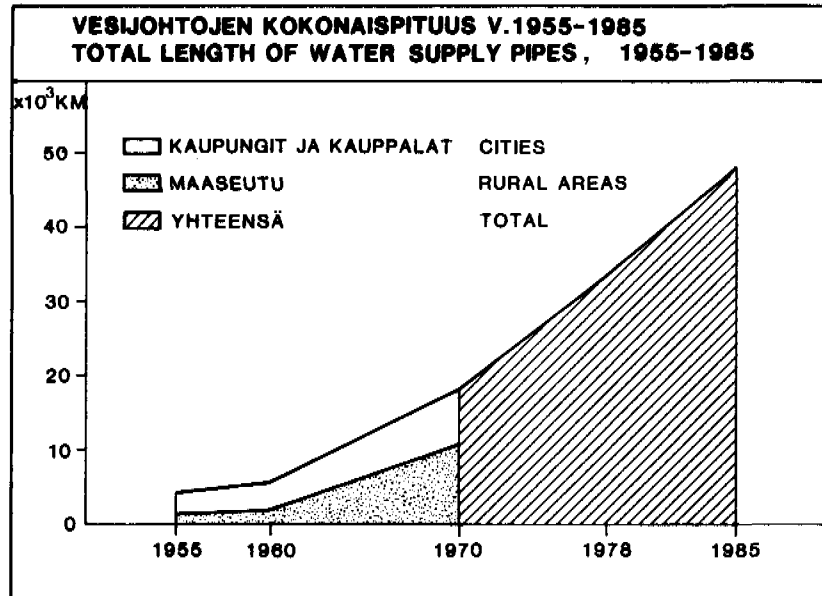


Fig. 26. The total length of water supply pipelines in 1955, 1960, 1970, 1978 and 1985 (Peräkylä 1967; National Board of Waters, 1971, 1979, 1986; compiled by the author).

Kuva 26. Vesijohtojen pituudet vuosina 1955, 1960, 1970, 1978 ja 1985 (kirjoittajan kokoama).

4.6 Changes in Ownership of Water Supply Schemes

Table 4 shows the development of ownership of water supply works starting in 1956; i.e. the number of water supply works and their relative share based on ownership. The data for 1956 cover only rural water schemes, and the data from 1972 onwards only include water schemes that serve a minimum of 200 people. The relative share of municipal works has risen drastically. Various types of associations and partnership form the second largest group, their relative share, however, is declining. The number of water works owned by industries has remained low, and is still declining. While the administration of larger water works has been taken over by municipalities, new cooperatives have been established in sparsely populated areas. Consequently, there are about 2000 water supply cooperatives in Finland today. For example in the municipality of Pudasjärvi, there are 28 water cooperatives (Meskus 1988). The role of cooperatives has been, and still is, crucial in the development of water supply services in sparsely populated areas.

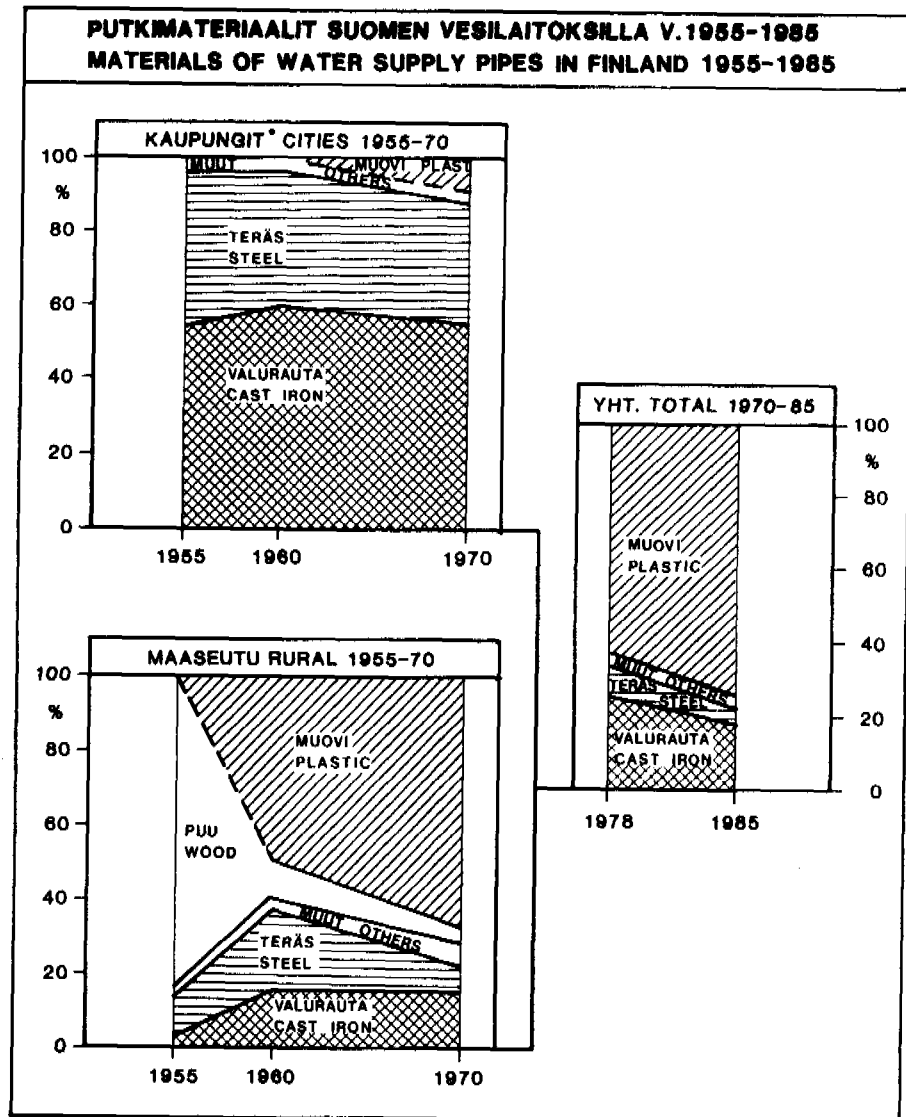


Fig. 27. The materials of water supply pipelines in Finland in 1955, 1960, 1970, 1978 and 1985 (National Board of Waters 1971, 1979, 1986, Peräkylä 1967; compiled by the author).

Kuva 27. Vesijohtojen putkimateriaalit Suomessa vuosina 1955, 1960, 1970, 1978 ja 1985 (kirjoittajan kokoama).

Table 4. The distribution of water supply works by ownership, 1956-1985 (The Delegation for the Assistance to the Water Sector 1974, Erkola 1958, National Board of Waters 1986, The Water Supply Committee 1967; compiled by the author).

Taulukko 4. Vesilaitosten jakautuminen omistussuhteen mukaan vuosina 1956-1985 (kirjoittajan kokoama).

Omistussuhde Owned by	1956 ¹⁾		Vuosi/Year 1963 ²⁾		1972 ³⁾		1985	
	Määrä No.	Osuus Share %	Määrä No.	Osuus Share %	Määrä No.	Osuus Share %	Määrä No.	Osuus Share %
Osuuskunnat Cooperatives	18	5	207	31	254	38	236	30
Osakeyhtiöt Stock companies	20		87	13				
Avoimet, varsinaiset ja muut yhtymät Partnerships etc.	116		81	12				
Kunnalliset laitokset Municipalities	-	-	154	23	324	48	477	60
Teollisuus Industries	-	-	46	7	43	6	28	4
Valtio, sairaalat jne. Government, hospitals etc.	-	-	84	12	54	8	48	6
Muut Others			13	2	-			
Yhteensä/Total			672	100	675	100	789	100

1) vain maaseudun vesilaitokset väh. 10 taloutta (only rural water supply works serving a minimum of 10 households)

2) vähintään 10 taloutta (serving a minimum of 10 households)

3) vähintään 200 asukasta (serving a minimum of 200 people)

4.7 Financing of Water Supply and Cost of Water

4.7.1 Financing

In 1950, allocations for constructing rural water supplies were made in the government budget for the first time. The National Board of Agriculture granted assistance to cooperatives that intended to provide water supply services to a minimum of five dwelling units. Of the shareholders of the cooperative 3/4 had to be small-scale farms with holdings of less than 15 hectares of arable land (Turunen 1985).

In 1950, the Committee for Rationalizing Households, i.e. "the Women's Committee" submitted its first report, called "Maaseudun vedenhankinta- ja viemäriolojen parantaminen" (Improving the Water Supply and Sewerage Conditions in Rural Areas). The committee concluded that the improvement of water supply conditions was the first and foremost among the efforts to rationalize households and husbandry. From 1951 onward, government loans and grants were offered for the construction of water supply and sewerage facilities in rural areas. According to this so called "financing law", loans and assistance could be granted to rural municipalities as well as to associations and private households, but not to cities. The loans were granted for 24 years, except for loans to municipalities, which had to be paid back in 10 years (Pekkanen 1968). Table 5 shows the government support in grants and loans for rural water supply and sewerage during the years 1950-1968. There was a significant rise in grants and loans in 1967 and 1968. Peräkylä (1967), however, concluded that the financing did not nearly meet the demand.

In 1966-1967, the loans provided by the National Board of Agriculture stood for nearly 40 % of the total investments in the water supply sector. The self-financing by the applicants amounted to about 30 %. As a result, the contribution by the municipalities in water supply projects was significant. According to Pekkanen (1968) associations are, however, very much needed to fill the void that cannot be covered by municipal water works.

According to a study by the Water Supply Committee (1967), the self-financing ratio for water supply works was 30-40 % per year for the whole country. About 15 % was covered from connection charges; government grants and loans stood for 10-20 %; and the municipal support amounted to about 10 %. The remaining 20-25 % was financed through bank loans.

Investments in wastewater treatment plants and sewer systems, but also water supply works, were significant in the mid-1970's (Fig. 28). The rehabilitation of existing networks has intensified during the last ten years.

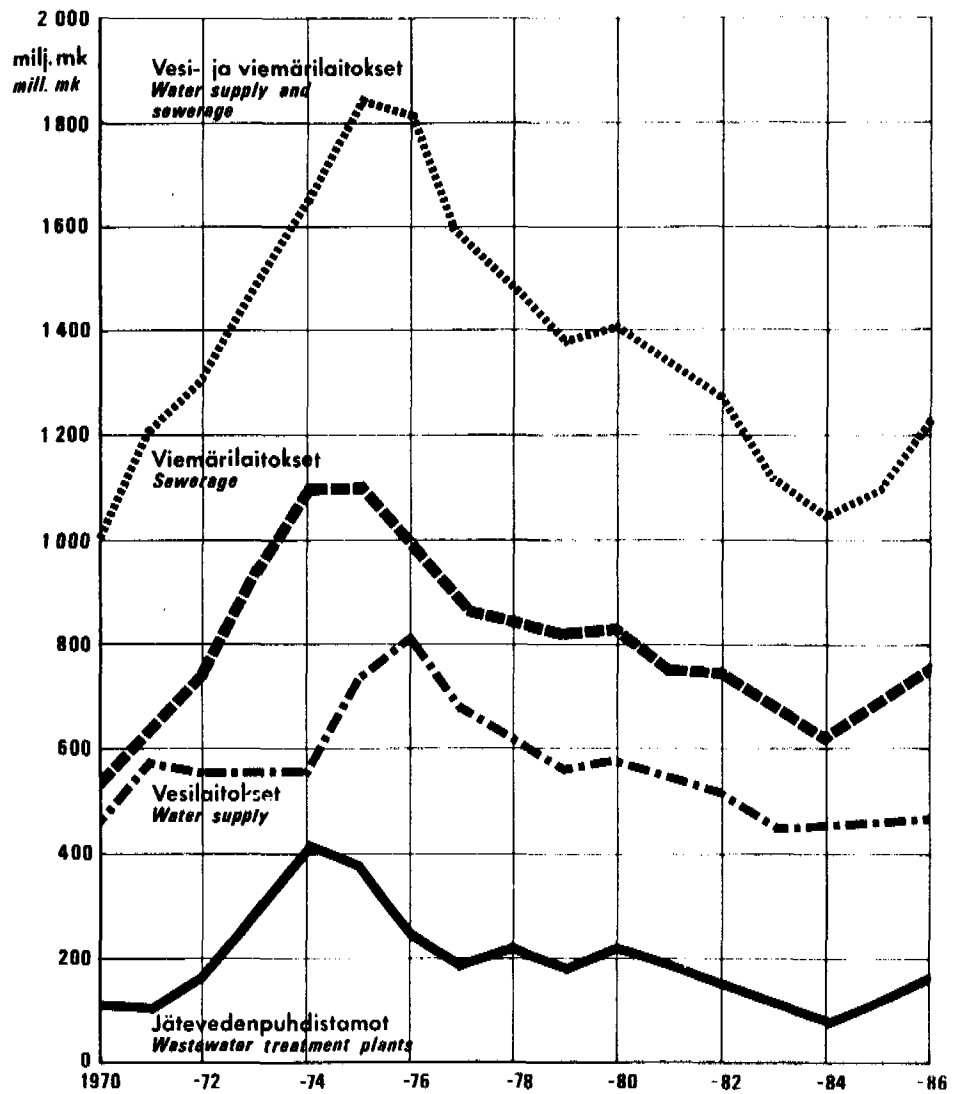
Table 5. Government support in grants and loans for rural water supply and sewerage, 1950-1968 (Pekkanen 1968).

Taulukko 5. Valtion ns. rahoituslakiin perustuvat maaseudun vesi- huoltoon tarkoitettut määrärahat 1950-1968.

Vuosi	Avustusta milj. mk	Lainaa milj. mk
Year	Grant FIM (millions)	Loan FIM (millions)
1950	0.1	-
1951	0.1	-
1952	0.1	0.1
1953	0.1	1.0
1954	0.2	0.5
1955	0.3	0.75
1956	0.3	0.5
1957	0.3	0.6
1958	0.3	1.0
1959	0.3	2.0
1960	0.6	2.4
1961	0.6	2.0
1962	0.7	3.0
1963	0.8	2.4
1964	0.8	1.8
1965	0.64	1.44
1966	0.72	2.62
1967	-	11.00
1968	-	18.00
Yhteensä Total	0.96	44.61

4.7.2 Water Cost

Harju and Erkko (1929) did comparative research on the costs of water for husbandry on 15 farms in southern Finland. Palosuo (1941) in his research estimated, e.g., the cost of carrying water. Table 6 illustrates the cost of various modes of water supply in 1940, and gives the same cost calculated at the 1986 price level adjusted by the cost of living index.



Vuoden 1986 hintatasossa, rak. kust. indeksi 150.6
 Price level in 1986 building cost index 150.6

Fig. 28. Municipal investment in water supply and sewer systems, 1970-1985 (National Board of Waters and Environment 1987).

Kuva 28. Yhdyskuntien vesi- ja viemärlaitosinvestoinnit vuosina 1970-1985.

Table 6. Estimates of the cost of various modes of water supply in the 1920's and 1930's (The Committee for Rationalizing Households 1950).

Taulukko 6. Arvioita erilaisista vedenhankintatapojen laskennallisista kustannuksista 1920- ja 1930-luvulta.

Vedenhankintatapa Mode of water supply	Kustannus Cost	
	v.1940 hintataso 1940 price level mk/m ³ (FIM/m ³)	v.1986 hintataso x) 1986 price level mk/m ³ (FIM/m ³)
Kannettava vesi Carrying of water (Palosuo 1941)	7.5	6.7
Ajettava vesi Transportation of water (Harju ja Erkkö 1929)	22.5	20
Sähkö- ja tuulimoottori Electrical or wind power (Harju ja Erkkö 1929)	3.4	3.1
Käsipumppu Hand pump (Harju ja Erkkö 1929)	3.2	2.9
Paino- eli gravitaatiovesi Gravity flow (Harju ja Erkkö 1929)	1.5	1.4

x) elinkustannusindeksin mukaan (using the cost of living index)

Transported water was most expensive, followed by carried water. The same committee estimated that mechanically pumped or gravity flow water was even cheaper in 1950 than indicated by the table, as compared to the cost of carried or transported water. According to Table 6 transported water was 15 times more costly than gravity flow water. At the end of 1986 the average price of water charged by Finnish water works was 2.90 FMk/m³ (US\$ 0.65) including water consumer fee, meter cost, and other fixed costs but excluding connection charge (National Board of Waters and Environment 1987). This price is equivalent to the cost of handpumped water as presented in Table 6. Water consumption was, of course, significantly lower in the 1920's and 1930's, but on the other hand, water treatment and networks were much simpler.

Palosuo (1941) set the price for a 20-hour woman's workday at 24 Fmk. About 16-20 minutes were used daily for fetching water, i.e. a total of 12-15 workdays per year. On farms with cattle, 40-100 eight-hour workdays were, however, used yearly for carrying water according to the Committee for Rationalizing Households (1950). If the average workhours of farm-wives are estimated at 15 hours on weekdays and 10 hours on Sundays, 5.5 full workweeks a year are spent on carrying water according to the above estimate. This amounts to 10 % of the total workhours per year. Because carrying water was perhaps the most strenuous task of farm-wives, the energy spent on this chore was, relatively speaking, even more significant. The World Bank has in the 1970's and 1980's in various connections, used a criterion, according to which the cost of water (or the effort put into providing it) should not exceed 5 % of the available income.

Table 7 gives examples of water and sewer fees charged by Finnish water supply and sewerage works for the years 1956, 1963, 1966, 1979 and 1985. According to Peräkylä (1968) in 1966 rural consumers paid more for water than their urban counterparts. This was due to the fact that a flat rate was generally applied in rural municipalities. The real cost of water has gone down since the beginning of the 1950's when compared to prices in 1985.

4.8 Water Supply Services in Sparsely Populated Areas in the 1980's

In 1985 approx. 1 170 000 people lived in sparsely populated areas in Finland. Since 1950 the population of these areas has gone down by more than 300 000 people every ten years. The definition of sparsely populated areas has been arrived at using a criterion commonly applied in the Nordic Countries. The definition of a densely populated area is a built-up area with more than 200 inhabitants, where the distance between dwellings does not generally exceed 200 m; remaining areas are defined as sparsely populated (Ministry of Agriculture and Forestry 1987).

Piped water has increased drastically in sparsely populated areas in the 1980's. It is, however, estimated that about 55 000 households have hygienic water quality problems, and about 80 000 physio-chemical problems. About 55 000 households encounter water quantity restrictions. In 1987 the task force established for developing water supplies in sparsely populated areas estimated that a total of 180 000 households encountered some kind of water supply problems, i.e. almost every second

Table 7. Examples of average water consumption charges in Finland, 1956-1985 (The Delegation for the Assistance to the Water Sector 1974, Erkola 1958, National Board of Waters 1986, Peräkylä 1968; compiled by the author).

Taulukko 7.

Esimerkkejä keskimääräisistä vesimaksuista Suomen vesilaitoksilla vuosina 1956-1985 (kirjoittajan kokooma).

Vuosi Year	Veden kulutusmaksu Water consumption charge			Jätevesimaksu Effluent treatment charge				
	Minimi Minimum MK/M ³ FIM/M ³	Keskiarvo/average		Maksimi Maximum MK/M ³ FIM/M ³	Minimi Minimum MK/M ³ FIM/M ³	Keskiarvo/average		Maksimi Maximum MK/M ³ FIM/M ³
	Arithm. Arithm. MK/M ³	Painoll. Weighted FIM/M ³			Arithm. Arithm. MK/M ³	Painoll. Weighted FIM/M ³		
1950...1955	0,50			1,25	-			
1963			0,52		-		yhtymät	
1966		0,40	0,65	1,25*				
		0,50	0,90	2,0**				
1972***	0,13	0,91	0,73	1,90	0,05	1,03	0,84	2,31
1985	0,30	2,54	2,90****	8,10				

* Kaupungit ja kauppalat, ei perusmaksuja (cities without non-volume based charges)
 ** maalaiskunnat, joissa usein perusmaksuja (rural communities often with non-volume based charges)
 *** perusteena ns. "normaalihinta", joka sisältää liittymismaksun (including connecting charges)
 **** sisältää mittari- ja perusmaksun (including meter and non-volume based annual charges)

household in sparsely populated areas. The task force has proposed that the water supply problems of 120 000 households in sparsely populated areas should be corrected by the year 2000 (Ministry of Agriculture and Forestry 1987).

The Delegation for Assistance to the Water Sector (1974) proposed in its report that government support should be extended to such water supply works that charge 50 % more for their water than the weighted average of all water supply entities. The proposal was not unanimous. It might be true that this support - if implemented - would have favoured water works that had not been operated on a sound financial basis.

5 DISCUSSION AND CONCLUSIONS ON THE IMPLICATIONS FOR THE DEVELOPING WORLD

5.1 Factors Influencing the Development

Finland was industrialized and has developed into a post-industrial nation at a very fast pace. In rural areas wells have presumably been in use for hundreds of years. In addition to private wells water sources operated by a few homesteads, or the whole village, were common. Public water supply schemes have developed along with the changes in the structure of the economy since the 1920's. Latrines, however, became common much later than wells in rural areas, i.e. only at the end of the 19th century. One could, therefore, draw the conclusion that the sanitation and health components that are often stressed in water supply development projects, are overdimensioned, or that water services should at least be provided some years before full integration is achieved.

Husbandry and its water needs have been crucial in the development of water supplies. Husbandry is an income-generating activity and has therefore received more attention than conveniences linked to the dwelling. This is a factor that must be recognized in development projects, keeping in mind though that an increase in heads of cattle may result in overgrazing.

Piped water has lightened the workload of women, particularly in households involved with cattle. Carrying water has been the most strenuous task of women on such farms. Piped water has become accepted when the work of women and the time savings have started to gain recognition. In Asia and Africa cattle is traditionally brought to the watering place.

Water has been lifted using various simple techniques. The handpump has not been dominant in Finland. The counterpoise lift and windlass wells have been very popular, and are still in use in some instances. In the developing countries, in conditions where maintenance of the handpump is difficult because of difficult access to parts, improved open wells should be considered. The wells could be provided with partially detachable covers. Among others, Berhane (1984) has suggested this solution for rural Ethiopia, and Katko (1987) for more extensive consideration in the developing countries. This solution has been tried in development projects funded by the US (Nagorski & Pineo 1988) and in Sri Lanka in an internationally funded project (Hukka 1988). With due respect to the worldwide handpumps development project, the handpump has perhaps too narrowly been considered just about the only suitable technical solution. The problems connected with handpumps installed in deep boreholes are evidently only beginning to surface (Anon 1988a).

In Finnish folk tradition according to old records water lifting devices that were in use were often labelled as "hopelessly outdated", when new more sophisticated technical solutions were introduced (Raittila 1987). This problem is particularly eminent in the developing world today, or at least in eastern Africa. Often the users want modern technical applications, even if they lack the resources for operation and maintenance.

The incidence of water-borne diseases declined with the introduction of public piped water in Finland. Safe water improves the health situation of the population, even if the results are not always quantifiable.

The development of public water networks and water supply schemes in rural areas depended on the availability of suitable pipe materials. In the beginning, wooden pipes served this purpose well. The wooden pipes were manufactured by local private entrepreneurs, and government had no part in this development. Later on, the manufacture of various metal and plastic pipes started in Finland.

Cooperatives were established, first especially in Ostrobothnia, to organize piped water supply schemes. In recent years, cooperatives have been founded in sparsely populated areas in central and eastern Finland to organize small-scale water supply schemes.

So far, the international development cooperation on government level has supported government organizations: in rural areas water boards and its regional administration. This support which, of course, in itself is important, has perhaps not encouraged the participation and initiative of the beneficiary population. During the last few years the participation of the beneficiaries has therefore been suggested as a solution. The participation per se is hardly enough to guarantee the operation and maintenance of a scheme in the long term.

Cooperatives and associations founded by the consumers themselves could, at least, provide an alternative solution for organizing water schemes in the developing countries. The input - monetary as well as in-kind - by the consumers should be seen as components of this institutional development. This would unavoidably lead to the introduction of water charges. At the same time, the idea that water supply is singularly a social service should be abandoned. In a meeting of international organizations in Switzerland in 1987, it was concluded that cost recovery should be one of the main areas of development in the water sector (WHO & SDC 1987). Research by the author on water costs has clearly indicated that the collection and administration of water charges often poses many problems. Therefore cooperatives and associations could be in a key-position when seeking solutions.

Government started to finance water supply undertakings fairly lately in Finland. This support has, however, been significant, particularly when constructing public water supply networks. The largest part of the investments has been paid by the consumers through connection charges and water fees.

In Sweden abt. 90 % of the dwelling units had piped water already in 1960. According to Pekkanen (1968), this was due to the fact that the government already for a long time had assisted water supply schemes. The role of the government had, however, been mostly to assist and promote.

In the US, rural water supply has also largely relied on cooperatives and associations. The Federal Government has provided financing to the sector since 1939 through the so called Farmers Home Administration (loans and grants). In 1974, over 90 % of the rural water supply schemes served populations of less than 500 consumers. In 1976, a national organization, the National Rural Water Association, was established. The World Bank is, in fact, in the process of preparing a study on how cooperatives and associations have evolved and how this partial experience could be transferred to the developing countries (World Bank 1988).

The role of cooperatives and associations in the water supply sector is connected to the role of the private sector in development cooperation. In recent years, this issue has also been raised in Africa (Killick 1987, Roth 1988, UNDP 1987).

Electricity was introduced to the Finnish countryside before cattle shelters and dwellings were provided with piped water. On the other hand, a water supply system based on wells and carried water dates far back in time. This would indicate that the introduction of piped water should not be rushed in rural areas in the developing countries.

The comparatively late development of water supply in rural areas in Finland can be attributed to climatic conditions. Winter conditions and a cold climate decrease the incidence of water-borne diseases significantly. However, in the 19th century high infant mortality rates used to occur in August, at the end of Finnish summer, particularly in settlements along river courses. Still in the 1940's some epidemics of typhus occurred partly influenced by the war situation. This was much due to inadequate hygienic conditions. The warmer climates in developing countries underscore the importance of safe water and sanitation. However, the experiences in Finland tend to show that water-borne diseases are not necessarily "tropical" by nature as commonly thought nowadays. Additionally fetching water and doing the laundry in the sub-zero temperatures of Finland have posed health hazards for women in particular.

In addition to the health benefits, an improved water supply can be justified by consequent time, or rather, effort savings. Studies undertaken already in the 1930's and 1940's indicated that transported or carried water was more expensive than pumped water. The time savings are of importance also in the developing countries, when comparing various technical alternatives for water supply.

The development of water supplies in rural and sparsely populated areas has emerged as a central issue toward the end of the International Water Decade in Finland. Despite differences in developmental levels, there are many common features in rural water supply conditions in developed and developing countries. Bates (1988) has concluded that the experiences gained from the Water Decade are applicable to developed and developing countries alike.

5.2 Further Research

The author of this study suggests that in-depth research be conducted, e.g., on the following topics:

- (i) Comprehensive study on the development of water supply and related sectors, such as health in Finland. The research should particularly focus on documenting unpublished experiences of the pioneers of the water sector, e.g. with help of interviews.
- (ii) The role of cooperatives and associations in the development of rural water schemes in Finland, and possibly in other Nordic countries. Finland's experience of water cooperatives and associations spans over 50 years and even today such entities play an important role (consumer contributions and participation; selection of technology; subsidies by the government; cost of water; provision of necessary services - training, maintenance etc.).
- (iii) Technology applied to water supply, e.g.: various water lifting devices, well construction methods, pipe materials, etc.

6 CONCLUSIONS

At least the following factors have been important for the water sector development in Finland:

- * The water supply for domestic animals has been considered economically more important than the supply of households .
- * The valuation of women's work has increased.
- * Ground water has been fairly accessible although sometimes of bad quality.
- * Locally available materials such as stone and wood were used in well structures before concrete became available.
- * In addition to handpumps, several types of simple water-lifting devices have been used. First handpump models were made of wood followed later by suction and pressure pumps made of cast iron.
- * Clear positive health effects have been derived from organized common water supply systems.
- * Wooden pipes were commonly used before domestic production of metal and plastic pipes.
- * Individuals have acted as initiators and managers of water supply.
- * Private small-scale enterprises used to manufacture wooden pipes and pumps.
- * Community-managed water cooperatives and stock water companies have a long tradition.

The experiences of modern developed countries, such as Finland, cannot be directly transferred to the developing world. However, there are still a wealth of knowledge and experience to be analyzed and utilized. It would be especially important to gather the still available knowledge about the development in the sector. Perhaps the best contribution would be the analysis of the development of community-managed cooperatives and other water associations. The tradition of these water associations in Finland dates back to the early 1900's and even today the associations are dominant in the rural areas. Research could also be done on alternative technological solutions.

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