DEVELOPMENT OF FOREST ECONOMIC RESEARCH IN FINLAND

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HELSINKI 1959

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Abbreviations

AFF Acta forestalia Fennica
KA Kansantaloudellinen aikakauskirja
MA Metsätaloudellinen aikakauslehti
MTJ Communicationes Instituti Forestalis Fenniae (Publications of the Forest Research Institute in Finland)
SF Silva Fennica
SMY Suomen Metsänhoitoyhdistyksen julkaisuja
SP Suomen puu, Suomen puutalous
SPP Suomen paperi- ja puutavaralehti
YMV Yksityismetsänhoitajayhdistyksen vuosikirja

Introduction

Forest economics in Finland is comparatively young as an independent part of forestry science. Not until 1922 was the office of Professor of Forest Economics — at that time called Forest Policy — established in the University of Helsinki, and the first person named to the position was Eino Saari in 1925. Business economics of forestry was separated from it to become its own field of learning in the year 1947, with Valter Keltikangas as the professor (1949). The science of marketing of forest products is expected to have its chair in the near future.

The Department of Research in Forest Economcis was established within the Forest Research Institute in 1928. Professor Yrjö Ilvessalo directed the work of the department in addition to his own work until 1938, at which time N. A. Osara was named the first permanent professor of the department. He was followed in 1950 by V. Pöntynen.

Even before forest economics received its official status at the University and the Forest Research Institute, there appeared within the circle of research scientists an interest in the problems of forest economics. And so, Finland's first notable forest scientist, A. G. Blomqvist, who is considered primarily as a representative of silviculture, dealt also with the questions of forest economics, particularly of forest policy, writing the first textbook in the field printed in Finland (Skogshushållningens nationalekonomi, 1893). Many practical foresters as well were busy on the problems of economics (e.g. P. W. Hannikainen: Suomen metsät kansallis-omaisuutenamme, published in 1896).

The following presents the main features of the research and publication work within forest economics according to the main fields of investigation.

Forest Economics from the Viewpoint of National Economics

Finlands Forest Resources and Forest Balance

The question of the balance between the national forest resources and their use has remained from the earliest times to the present one of the most important and most often dealt with questions. Attempts to estimate the balance between the growth and fellings of forests were made even in the nineteenth century. As the shifting cultivation of forests was still particularly common at the end of that

century, it is no wonder that these estimates were generally influenced by the fear that the forests would disappear. For example, A. G. Blomqvist, in his textbook of forest economics, was anxious about the fate of the forests in the populated areas. Methods of national forest inventories were developed principally by Yrjö Ilvessalo and of surveying national wood use by Eino Saari (1922 MTJ 5). On this foundation was built the first inventory of national forest resources, carried out during the years 1921—24 (Ilvessalo 1927 MTJ 11), and the first national survey of wood use made in 1927 (partially for the period 1911—1932) (Saari 1934 MTJ 14, 1920 SF 11). It is true that these first basic surveys did not present possibilities for very far-reaching conclusions about forest balance. They indicated, however, that although 1927 was a boom year for forest products and the use thus exceptionally large, the total drain estimated on the basis of use did not, to an alarming degree, exceed the growth. This gave rise for a more optimistic view than before of the future of Finland's forests (even of the possibility of doubling the growth) (Saari and Ilvessalo 1929 SF 12). The exchange of ideas on this question was greater than before. Saari had above all discussed the fundamental principles of the question of forest balance and an adjustment of the problem itself, as well as the basis for increasing the cut (1937 YMV 10, 1942 and 1948 KA).

When an inventory of forest resources was taken for the second time during the years 1936—38 (Ilvessalo 1942 MTJ 30) and, correspondingly, a new national wood use survey was made for the year 1938 and at the same time partially for the period 1911—1947 (Osara—Pöntynen—Erkkilä 1948 MTJ 36), a basis for calculations of forest balance, much more dependable than previously, was obtained. It appeared that, during the interval between the investigations, the drain and the growth had been, roughly, in balance; only during a few boom years for forest products had the total drain exceeded the growth. This balance, however, was not due to intentional regulations.

In this, as in the previous phase of wood-use research, was included a large amount of special studies; for example, the use of wood by the rural population (Erkkilä, e.g. 1943 MTJ 32) and the question of our country's forest grazing (Jäntti 1945 AFF 53). Very special attention was given to the consumption of wood for raw material and for fuel in manufacturing industries. These numerous statistical reports (e.g., Pöntynen 1931 AFF 37 and 1936 AFF 45; Hilden 1930 MTJ 14; Hartikainen 1939 MTJ 27 and 1940 MTJ 28; Solitander 1943) received their impetus from two problems of economic policy which have continually drawn attention. On the one hand, there was great concern on the industrial level about the exports of roundwood, particularly pulpwood, which forest owners considered to be very important as a price regulator. On the other hand, forest owners have always viewed unfavorably the ever-growing imports of foreign fuels, which affects the outlet of small-sized wood, important from the silvicultural point of view.

When the third inventory of national forest resources for the years 1951—53 was gotten to the results stage (Ilvessalo 1956 MTJ 47), it was seen that, despite the fact that as a consequence of the war 13 % of the forest area (3.2 million hectares) had been relinquished, the growing stock had nevertheless decreased by only 4 % and the increment by 1.5 % as compared to the previous inventory. The growing stock and increment in terms of averages per hectare and also the per cent of increment had increased.

This unexpectedly favorable result gave rise to a lively dispute about its causes and its presenting of possibilities, for instance, for the expansion of forest industry. In this discussion the felling plan, calculated and recommended by Lihtonen, had been used advantageously (1943 AFF 51 and 1946 AFF 53). As this is being written, the as yet uncompleted third wood-use survey under the direction of Pöntynen seems to indicate that the actual fellings in 1950th are about the size of the recommended felling calculated by Ilvessalo (MTJ 47). As forest industries also are greatly expanding, it is necessary continually to follow the development of the forest balance.

The latest results of production research (e.g., Nyyssönen: MTJ 49, 1958) have given more confidence in the future. The credit side of forest balance has to this point been founded on the use of wood. Theoretically, a more accurate way would be to use the quantity of fellings. With this in mind, attempts have been made to develop usable statistics on felling, for which Holopainen has recently outlined a method based on random sampling (1956 SF 89).

Forest Ownership Policy and the Forestry of Different Groups of Owners

In Finland, perhaps more than in many other countries, there has been a controversy going on regarding the best structure of forest ownership. The main categories in this discussion have been the farmers, the State and the forest industries. The actual land use policy (agricultural land vs. forest land), after the era of shifting cultivation, had been discussed seldom (Vöry 1946). The forest has regularly had to make way for the agriculture without preventing it by law, and this development has actually been encouraged by the supporting measures of the government.

The discussion concerning the questions, whether State forests and forests owned by forest industries companies ought to be given to the farmers, is rarely scientific in nature. In Finland, the main problem has often been the comparison between the necessities of the social policy contra the drawbacks in the national economy. Nevertheless, it has also been attempted to study scientifically, partly starting from a theoretical viewpoint and partly from data obtained from experience, the qualifications of different forest owner categories for the practice of successful forestry. At the end of the 19th century many forest committees

presented ideas about this problem, and in his textbook appearing in 1893, A. G. Blomqvist gave the matter much attention. The basic feeling at this time was one of pessimism regarding the possibilities of farm forestry.

The anxiety about the forests in possession of farmers has especially given cause for many investigations into the forestry, forest resources, and use of forests by the various groups of owners.

Cajander (1921 AFF 18) and Lihtonen (1949 SF 66) have written about the State forestry and its special features. The colonization of government forests has given rise to a group of investigations (Heikel 1912; Pekkala 1920 AFF 17; and Jokinen 1939 SF 49). Saari has studied one of the country's toughest and most complex forest-ownership questions in Carelia (1919 AFF 12).

Linnamies and Rautvuori have published economic-geographical accounts of the forests of communes (1939 MTJ 28 and 1941 AFF 50). Lappi-Seppälä has studied the development of parish-owned forests before their noticeable reduction by expropriation resulting from World War II (1940 AFF 49).

After the middle of the 19th century, forest industries in Finland attempted to secure its raw material needs by buying forests, often total farms. This evoked a strong resistance, principally amongst the farmers, which finally led to the limiting and reduction by law of industrial land ownership (Harve 1947 AFF 52). This discussion, however, gave cause for the demonstration of the high level of the industries' forestry (Renvall and Boman 1920 AFF 13 and 1921 AFF 19; Sohlman 1928 YMV; Lindfors YMV of various years).

Much attention in Finland's forestry has been given to the needs of the legislative and advisory work striving to regulate and develop the farm forestry, both in connection with the national forest inventories and otherwise as well. By his investigation (1935 MTJ 21), Osara called attention particularly to the problems of small woodlots and, in general, to the distribution by size classes of private forests (1936 MTJ 21). Of the later studies of private forestry, the following investigations published by Tapio may be mentioned: Erkkilä 1943, Ilvessalo 1948, Holopainen 1957 (SF 94).

Forest Legislation and Forest Taxation

The legislation regulating private forestry is based primarily on committee work. The description, interpretation, and effects of the policies and phases of this legislation have given rise to a few publications (e.g., Liljestrand 1878, Laitakari 1923, Toijala 1934 AFF 40, Komsi—Pelttari—Toijala 1937, and Ennevaara 1946 AFF 54).

In 1922 a special type of system was introduced into Finland's forest taxation, in which the regional average increments of the forests, and the actually obtained stumpage prices together are the starting point for the calculations of taxable »income». The application of this principle and its development has provided

much continuous work for the Forest Research Institute (Ilvessalo 1933 Metsätietoa I, 6, and 1937 SF 42). On the other hand, the principle itself has provoked criticism (Saari 1933 KA; Lento 1956 Kansantaloudellisia tutkimuksia XVIII; Selin 1953 AFF 61), in which the taxation of actually received net income of the individual enterprises has been recommended.

Forest Labor

In the beginning of the 1900s the growing awareness of social responsibility lead to an interest in forest workers as well. At the commission of the government, preliminary studies were made of the workers' social conditions in the years 1910—11 and 1921 (Snellman and Harmaja). In this way the grounds were laid for legislation, which set the minimum requirements for the housing and nutrition conditions of camps. Lähde has studied this development (1940 SF 51).

The extensive unemployment of the 1930s created interest in the possibilities of forestry to provide employment for people. Helander had as early as 1923 (AFF 26) investigated the amount of man power used in State forestry. Later it was treated from various sides; for example, Lakari (1934 AFF 40), Pelttari (1935 SF 35), Lindfors (1937 SPP), and Pöntynen (1936 AFF 42). The last mentioned was the first attempt to estimate the size of the labor force used in the logging of wood for market in the whole country and to estimate also its seasonal variation.

The wage level of forest workers decreased during these times to such an extent that it was necessary for the government to introduce regulations (Hellen 1958 SF 96). Because the work in the forests is mainly piece work in Finland, this required studies for the development of a correct wage-rate system (Lindfors 1942 SP). By their nature, these investigations are in the field of forest utilization, for which reason they are discussed elsewhere. It ought to be mentioned here that the wage-rate relationships and computing methods were developed by Olli Makkonen on the basis of this fundamental research (1950 Metsäteho 25). During World War II and right after there was a deficiency in the forest labor force. This, as well as the need for nation-wide economic planning, gave reason for sample surveys of Finland's rural labor force, carried out by the Institute of Forest Economics at the University of Helsinki with methods developed by it. From these surveys information was obtained regarding the utilization and conditions of the whole labor force in forestry, its structure, seasonal variation, housing conditions, and development (L. Heikinheimo, et all. 1954—56 AFF 63). These studies lead subsequently to the starting of a general, current labour force sample survey.

The question about the labor force of forestry has been studied from other angles as well. Of these may be noted the questions pertaining to the permanent employment of the labour force (Luoma, Torckell, and Lindfors 1929 YMV; Suo-

minen 1955 SF 86), which have been timely after both World Wars when there was a shortage of labor force in forestry, as well as investigations into the amount of man power used in farm forests and the use of time by forest workers (Piha 1954 AFF 61, and Hakkarainen 1957 Metsäteho 35).

Forest Geography

The studies of Finland's forest resources, mainly the national inventories of the forests, belong by their results to forest geography. Of the other investigations which should be listed in this group is the work by Lauri Ilvessalo and Matti Jalava of 1930 dealing with the forest resources of the world, the comparison of the forest resources of the North-European countries (Y. Ilvessalo 1931 MTJ 14), and the plant geographical studies based mainly on the theory of forest types (such as Lukkala 1919 AFF 9; Cajander 1923 AFF 25; and Linkola 1922 AFF 22).

Forest Industries and Wood Transportation

The studies concerning the forest-ownership policy of industry have been mentioned previously. In them, especially Renvall (1914) discussed the question of the importance of forest industries to the economy of the country in general and to the possibilities for the improvement of agriculture in particular. Of the general reports in this field, Kovero's »Suomen vientiteollisuus» (Finland's Export Industries) of 1926 ought especially to be mentioned.

The costs in Finland's forest industries and also the distribution of the gross income among the industry, the long-distance transportation of round wood, the forest work, and the forest owner, has been investigated by Saari separately in the pulp industry (1931 AFF 37) and in the sawmill industry (1932 AFF 38). The information regarding the ratio of the stumpage price to the value of finished products was especially interesting. L. Heikinheimo has tried to follow the subsequent development in his study (1954 AFF 61).

The investigations concerned with the economics of wood transport have stirred up the conflicting opinions about the advantages of land vs. waterway transportation of round wood. Also, the form of the log-floating organization of the vast Saimaa waterway system has long been a source of controversy between industry and forest owners. Seppänen attempted to find the most advantageous solution for this from the viewpoint of national economy (1937 AFF 46). He also studied the possibilities for the use of the remote forest resources of northern Finland (1939 AFF 47).

The forms and costs of the long-distance transportation of industry's round wood have been studied by Seppänen and, later, by Lindfors (1943 SPP, 1954 and 1956 SP). Roitto, in his dissertation, investigates the factors affecting the determining of the forms of waterway transportation (1958 AFF 67). The forms

of longdistance transportation have also been discussed by Lihtonen (1948 AFF 55) and Kiiskinen (1953 Taloudellinen tutkimuskeskus B 5). The profitability, in terms of both national and private economy, of the different forms of the long-distance transportation of wood has by no means reached an indisputable solution.

Marketing of Forest Products

In the sphere of market research of forest products, two distinct groups can be discerned: 1) that concerned with commercial practices, and 2) that concerned with the market. Of these, the first group is very closely connected with general commercial research.

The reports concerned with commercial practices, for those parts which are considered to be in the field of forestry, have been for some time almost entirely descriptive, picturing the facts worked out in practical life. They are to be regarded mainly as textbooks and handbooks. One obstacle to theoretical analysis might have been the fact that basic commercial training has been almost entirely lacking in our forestry education right up to the days of World War II.

Of the questions connected with the domestic market, those most discussed are the various forms of timber trade, the buying and selling of wood lots, the purchase and measuring of timber, and assortments of timber. On the side of the foreign market there have been presentations mainly on the matters of export sales, organization, commercial practices, commercial legislation, knowledge of types of products, measurement of export products, and shipping with related matters. The first of these books were published at the change of the century, and they were concerned with the domestic trade, mainly intended for the forest owners. Since then numerous independent and joint explanations of these questions have been published. Some of the latest of these compilations are »Vienti- ja laivauskirja» 1949 (Export and Shipping Manual), »Puutavarakaupan jatkokurssi» 1954—58 (Continuation Course of Timber Trade), and certain parts of »Puutavarakaupan käsikirja» 1949—50 (The Timber Trade Manual) and »Metsäkäsikirja» 1956—57 (Handbook of Forestry).

Into this group also fall some publications which are investigational in character. Runeberg has done research on the work of timber agents, presenting his opinion for the improvement of organization and about the viewpoints to be considered in connection with it (1950 AFF 58). Vuoristo studied the relative values of pine saw-logs on the basis of extensive data. Before his death, only the first part of his studies was completed, in which the question was considered only from the viewpoint of selling price (1936 MTJ 23). The same question has later been investigated by a board for price determination of sawlogs. — During the second World War and right after, it was found necessary to make many presentations

with explanations on the regulative instructions and fixing of prices in the timber trade.

The studies on the market for forest products have also, to a noticeable extent, been descriptive reports of events and figures gathered from statistics and public records. Already in the second decade of this century, both Renvall (1910) and Paavonen (1911 SMY 1) wrote the basic expositions regarding the export of Finland's forest products and Hanho (1915 SMY 3) regarding the economic history of the sawmill industry and the export of sawn goods in the mid-1800s. After the first World War the first problems arising in the foreign timber market of independent Finland, such as the export duties on timber and the direction of export, were discussed in many brief treatises.

During the interval between the World Wars, attention was still drawn to general reports of a statistical nature, of which might be mentioned Pöntynen's investigation of the export of semi-processed and round wood (1932 AFF 38) and Saari's (1936) study of the sawmill industry of the North-European countries and the export of coniferous sawn wood. When the competition in the world market in the 1930s grew considerably tighter, it was found necessary to investigate certain questions, about which at that time there was not sufficient knowledge, but which were important from the viewpoint of competition. In the series of the Foundation for Forest Products Research in Finland there appeared at that time extensive accounts by Jussila (1937, 26) and Brommels (1931, 2; 1932, 8; 1934, 16) of the use of sawn goods in Great Britain, Belgium, France, and Spain. The information was largely from study trips and based on personal interviews and observations. Although the scientific worth of the studies was perhaps not great, from the standpoint of the practical sawn-goods market these reports were at that time valuable.

In the same series with the former reports, other reports were published about limited special questions important from the standpoint of export trade, such as the bluing of sawn goods during the sea voyage (Jussila 1932, 3), the time study of the loading and shipping work (Siimes 1935, 21), and directions for the grading of domestic and export sawn goods (1936). In 1933 Olin completed his creditable investigation of the competition of Finnish sawn goods in the international market. In conjunction with his work concerning the relative values of round saw logs Vuoristo also studied price relations of sawn wood (1935 MTJ 20). In the previously mentioned investigations of Olin and Vuoristo appear clear attempts to examine the cause and effect relationships as well.

During and after the second World War it was necessary to discuss again the question of the prospective market for forest products. With that in mind there were carried out, for instance, a brief investigation by Pöntynen of the opportunities of Finland's forestry and forest industries to carry on business depending on the Continental European market (1942 AFF 50), a study by Holopainen of the prospects of Great Britain's import of wood for pit props (1952 MTJ 40), and

the investigation by Runeberg of the forest-product trade between Finland and the United States and the possibilities for its development (1946 AFF 54). In these, as in later investigations, more attention has been given to the close examination of the causes and their effects than before. Holopainen has dealt with the fluctuations of Great Britain's import of coniferous sawn goods and the factors affecting them (1953 MTJ 41). From the point of view of methodology the section about the price elasticity of demand is especially interesting. Holopainen has also studied the seasonal fluctuation of Finland's export of coniferous sawn wood (1954 AFF 61). This has been accomplished by taking the calculation of the seasonal index as the starting point. The studies made by Ervasti deal with the sawn-wood market, composition and price relations of exported coniferous sawn wood (1955 AFF 64 and 1958 AFF 67). Of the investigations belonging to this group carried out during the last two decades by persons other than forest scientists, the most important have dealt either partly or entirely with the economic history. Some of the most notable are Kaukamaa's (1941) and Rinne's (1952) studies of the forestry and export of forest products in the Pori area in the 1800 s; Hautala's (1956) investigation of Finland's tar trade, its period of prosperity and decline and the factors affecting them; and Halme's (1955) thesis on Finland's export as a factor of business cycles.

Research on the domestic markets has remained comparatively small. In this field can be mentioned Hartikainen's brief account of the home market for sawn goods in 1932 (1934 AFF 40) and in 1933 (1935 Suomen Paperi- ja Puutavaralehti) and Holopainen's broad investigation of the market areas of fuel wood (1950 AFF 59). It was intended that the former study would be repeated annually, but unfortunately such has not been the case.

In this group can also be included the statistical reports concerning the price development of domestic round wood and products of forest industries (Saari 1924 AFF 17; L. Heikinheimo 1954 AFF 61; Selin 1958 MTJ 48), in which attention has especially been given to the development of stumpage prices. One reason for this might have been the current heated political debates on stumpage prices.

Thinking of the future, it would be desirable from the standpoint of market research that the range of subjects investigated would be further broadened and that attention would be given especially to the development of research methods and to causality analyses.

Business Economics of Forestry

Of the business economics of forestry, forest valuation and balance sheet problems have been studied the most, of which one can watch their being molded into their own Finnish lines. Less attention has been given to cost and profitability calculations. Exceptions in this respect are formed by the profitability of draining forest land and, during the last years, the determination of

rotation, about which questions have been published many studies. The first investigations in the field of logging have been concentrated on the calculation of logging costs and organizational theories.

The studies concerned with forest valuation were at first based on the land expectation value theory, in which a separate value was counted for bare land as an expectation value, and for growing stock a separate value as the realization, expectation, or cost value, generally using a 3 %, or the so-called forest rate of interest. On this basis Ericsson (1895) and Heikkilä (1930 Maa ja metsä) have examined forest valuation.

Ilvessalo proceeded to the value of newly reforested land and to 5 % interest. He has calculated the approximate money values for newly reforested land by forest types on the basis of results from national forest inventories. In addition, he has computed the relative soil values for different forest types by taking into account also the stoniness and marshiness of the land within the limits of the types (1938 Maanmittaus). They have been included since 1931 in the Tapion taskukirja (Handbook of Tapio), later editions of which have been supplemented by corresponding figures about the expectation an cost values of growing stock. Values of newly reforested land have been intended principally to become directions for the determination of value relations, and in calculating them the afforestation cost is subtracted from the final yield, from which the revenue from thinnings is evaluated as per cents.

Saari has devoted attention to the uncertainty of the value of bare forest land when calculated as an expectation value (1933 KA). Keltikangas has made a comparative study of the methods presented up to this time for the calculation of the value of forest land with the conclusion that by none of them could scientifically dependable results be obtained, because the distribution of income from fellings between the land and growing stock does not occur on the market. Uncertainty enters into the methods also in the calculation of relative values. The difficulties of determining the value of land do not affect the profit and loss account calculations, because it has been attempted to eliminate material pertaining to calculations of assets. In time and enterprise comparisons, relative land values are needed for which the values based on Cajander's system of forest types are best suited (1939 AFF 47, 1951 Maanmittausinsinöörien Liiton Aikakausikirja).

Saari (1940 SF 55) discusses the determining of the value of large forest areas. The value of a large forest is considered to be best calculated as the forest's expectation value based on actual or planned fellings. Because in the forest the boundary between productive capital and produce in felling is not objectively determinable, neither can there be an objective value, but rather many subjective values depending upon the way in which the forest is treated or planned to be treated. Saari recommends 4—5 % for the interest rate. The necessity of compound interest, when revenue and expenditures of different periods are compared, has been justified by Keltikangas (1941 and 1942 MA).

Keltikangas (1947) has made a systematic comparison of the opinions concerning forest valuation held in Finland at present and has explained in detail the reasons for them. A forest managed as a unit or a part of it must be dealt with in calculating its value as an entity formed by the forest land, growing stock tied up in production, and different stands. From that can be separated only the part of the growing stock which is not tied up in production, or realizable growing stock, according to the working plan. As a new method he presents Saari's forest valuation by the method of possible cut. According to this method as great a portion of the present growing stock will be calculated as cut during the time of the calculation or within a few years as is possible within the limits mostly set by the forest law and the size of the forest unit. Because the area of the forest to be evaluated limits the possible cut in such a way that in small forest areas a relatively larger part of the growing stock can be cut than in large ones, the hectare prices of the small forest units become by calculation correspondingly higher than those of the large ones. This sort of trend, according to Keltikangas, is also indicated by the hectare prices actually paid for forests (1954 AFF 61). Forest valuation by the method of possible cut is to be considered a general method, of which the customary expectation value is an exception appearing in large forest areas. The interest rate as set by Keltikangas is 4—5 % on the grounds that those circumstances which defend a low rate of interest, such as the rise in the price of wood and the possibilities for reduction of the growing stock, are taken into account directly in the evaluation of income from fellings and not in the interest rate. This reduces the per-cent range of the interest. The per cent of interest is of the same magnitude as that generally used for long-term investments in real capital. In the presentation is also contained a proposal of the methods which can be used in forest valuation for calculating compound interest.

In his thesis dealing with the value relationships of arable land and forest land, Lappi states that more just results will be obtained by the valuation of the forest rather than forest land (1948 Maanmittaustieteiden seuran julkaisu 6). Ahonen has shed light on Finnish forest valuation methods on the basis of examples taken from experience (1957 Metsäkäsikirja 2).

The balance sheet theory in forestry began receiving attention in Finland in connection with the attempts to improve the system of forest taxation. Keltikangas examines the expenditure items appearing in the calculations of the economic results from the viewpoint of profit and loss account. The main consideration has been given to the analysis of current expenditures and the depreciation of investments (1934 AFF 40). In his publication giving direction for Finnish research on profit and loss account and balance sheet calculation in for-

estry, Eino Saari concentrates on the outlining of the most essential problems and of the methods of solution proposed for them. As the most difficult, but at the same time the most central, problem, he considers the determining of the yield cut, capital cut, and capital accumulation (1935 SMV). As his own suggestion for a solution, Saari proposes the so-called method of periodical yield, according to which the yield cut is ascertained on the basis of a working plan drawn for relatively short periods of time, e.g., for a ten-year period. The possible capital cut or capital accumulation are determined by comparing the fellings of the fiscal period to the yield cut calculated on the average per year as indicated by the plan. The writer divides the other wood balance sheet methods into growing stock methods and yield methods, according to the sustained yield idea upon which they have been founded (1937 Metsätaloudellinen aikakauskirja). Saari recommends that his method of periodical yield be used, for example, in the calculations of the annual economic results of State forest ranges and districts, discussing at the same time the distribution of expenses into current expenditures and investments as well as transitory items (1938 SF 46).

The problem of wood balance sheet becomes an object of thorough exposition in Keltikangas' thesis. The author makes a systematical grouping of wood balance sheet methods and studies the way in which each of them answers to the special characteristics of practical forestry, especially in the conditions of Finland, and in what degree the different methods are in concordance with the demands of dynamic balance. Based on the principle of tiedup stock, the author indicates that by the growing-stock method can be obtained only a growing stock difference indicating changes in property, but by them cannot be explained the capital cut or capital accumulation. The wood balance sheet fulfilling the requirements of dynamic balance can be worked out only by yield methods. In his comparing of the method of sustained yield presented by Ostwald and Saari's method of periodical yield with each other, Keltikangas confirms the latter's having many both practical and theoretical advantages. In its being limited to ordinary economic time intervals, it can be adapted, without any special major adjustments, to forest units for which economic plans have been made. As a method independent of set economic goals, it conforms better to the dynamic changes of the growing stock. Furthermore, the author indicates that the method of periodical yield gives, in terms of balance sheet theory, more correct yield cut in subnormal growing stock than the sustained yield method. On the other hand, however, he warns against expecting too much from the wood balance sheet. In the study has also been examined the formation of reserve funds from income from capital cuts and its use for different purposes (1938 AFF 45).

Ilvessalo (1939) has calculated the net income for normally stocked forest of different types. The figures indicate the kind of results that would be possible to achieve in Finland. On the other hand, the author notes that the actual growing stock in our forests is so weak that the yield calculated for them would apparently

remain at the most 1/3 to 1/2 the results presented by the normally stocked forest.

In his investigation into the income of southern Finland's farm forests, Saari calculates the net income by subtracting the actual cash expenditures and expenditures in kind from the sum of the cash revenues and revenues in kind. Material for the study is taken from the farm bookkeeping system of the Board of Agriculture. The author notes the fact that on the basis of available data one cannot draw conclusions as to what extent the fellings carried out on different places vary from the amount of fellings established by sustained yield, bringing up the question of wood balance sheet and the necessity to separate current expenditures and investments in profit and loss accounts (1929 AFF 34).

On the basis of data obtained from the bookkeeping system of later years, Piha in his thesis analyses the net income of farm-forest units, its composition and dependency on such things as the size of the forest unit, its relative area in respect to the size of the arable land, and its location in different parts of the country. The relatively greatest net income has proved to have been received from small and average sized forest units joined to large cultivated areas (1941 AFF 49). In his further study, Piha examines the relationships between farm capital and the cash income received from the forest, particularly from the standpoint of agricultural investment, noting that the forest income determines both the direction and to a large extent the level for the investments in agriculture (1957 AFF 65). Metsäpelto (1942 AFF 49) has presented calculations about the net income of Finland's community forests, and Lappi-Seppälä has studied the net income of the parish forests of Finland (1942 AFF 49).

The first presentation of the balance sheet and profit and loss account theory in forestry as a whole was prepared by Keltikangas (1946). In it appear the doctrines as well as representative views of the investigators about the most important questions of the field. In comparisons illustrated by examples and diagrams, the main questions and the factors affecting their solution are analyzed and, as a result, our prevalent conception and its methods is formed. Ahonen has explained the principles of Finland's forest balance sheet and profit and loss account theory of the basis of numerical examples taken from practical life (1957 Metsäkäsikirja 2).

The economic goals of forestry have been dealt with by Hagfors, who groups the theories of forest economics into the productivity theories, the cost of production theories, and the profitability theories, and compares them with each other. He feels that the dynamic theory of economics reaches the goal in its striving for a maximum expectation value for the forest (1929 AFF 35). Hagfors has also dealt with the goals of forestry according to groups of forest owners (1930 Maa ja metsä) and König's production principally from the viewpoint of the theory of forest economics (1936 AFF 42).

In the field of profitability calculation, Tanttu (1941) has published the study

regarding the profitability of forest land drainage. He measures the profitability with differential utility, which can be received by discounting the profit from the cutting to the time of ditching, and by comparing it with the total of the basic costs of ditching and costs of maintenance discounted for the same time. The attitude of Saari is more cautious about the calculation of the profitability of forest ditching. Even the methods correct in principle cannot be used in computing the absolute profitability of forest ditching. He presents a new method in which the calculated difference of yields before and after ditching will be compared to the ditching costs (1942 AFF 50). Keltikangas has dealt with the classification of swamp types according to profitability of drainage in his studies of the succession associations of drained swamps (1945 AFF 53). In a further study he discusses especially the economic order of suitability for ditching of different swamp types, analysing Kaitera's (1947) calculation of the decisive effect of the growing stock on the ditching value of the swamp. Keltikangas comes to the conclusion that even though the economic ditching value can be appropriately determined on the basis of swamp types, the growing stock has such a strong effect on the ditching value that it is not suitable to bind the economic and biological classification of the swamps too closely to each other. The author recommends the concentration of ditching in fairly large areas where there is an abundance of high quality swamps, and increasing the profitability of ditching by joint drainings by several forest owners (1951 AFF 58).

Vuokila deals in his thesis related to forest mensuration with the determination of the most profitable rotation period. He suggests for the rotation period of managed Norway spruce stands on OMT and comes to the optimum period of 70 to 100 years, which have generally been used in Finland. He seems to feel that the determination of the economically optimum degree of thinning is more important than the determination of the optimum rotation period (1957 AFF 66). Nyyssönen, on the other hand, views the problem of the optimum rotation period on the basis of normal forest marginal profitability. He confirms that the differences of rotation periods on OMT, MT, and VT are from 10 to 15 years, if all comparisons are carried out according to 3 % marginal profitability. On CT the period of rotation will be 40 years longer than on VT. The author leaves it to the forest owner to decide what rate of interest will be used in the calculations (1958 MTJ 49).

The estimation of costs in the logging has been discussed by Keltikangas. He has discussed the post-calculation of the logging costs and its functions and methods (1950 Puutavarakaupan käsikirja II). Harve deals with the precalculation of the logging costs (1950 Puutavarakaupan käsikirja II, and 1957 Metsäkäsikirja 2). Einola studies in his thesis the joint costs occurring in logging and their effects on the method and structure of cost calculation. He shows that a considerable part of logging costs are joint costs. To cover the sunken costs, as the author calls that part of the costs which does not return as savings from other

costs and as income, the contribution margin formed as the difference of income and costs in planned procedures will be used. Sunken costs are not allowed to affect the placing, extent, and structure of the logging (1957 AFF 66). Einola presents also the practical application of post-calculation and bookkeeping for the logging costs (1957 Metsäkäsikirja 2).

In the field of the study of the administrative organization Halmekoski discusses the functions, arrangement, and structure of the forest division of the forest industries enterprises on the basis of data received from six forest divisions. He notes that the structure of the organization of the forest division depends primarily on the purpose of the work, the conditions, and the professional skill and experience of the personnel in the organization. On the basis of observation data and theoretical principles formed by him, he has concluded that part of the differences in structure are the results of the deficiency in organization.

History of Forestry

The most notable publication in this field is Suomen metsätalouden historia (A history of Finnish Forestry) by A. B. Helander (1949). It is an extensive textbook with color given by the enthusiastic author.

More brief historical reviews have been written in different fields of forestry, such as those about the State Forest Service (1934 Hertz AFF 43), the teaching of forestry (Kivinen—Laitakari 1958 SF 95), the extension service in private forestry (Holopainen 1957, Järveläinen 1940, and many local histories). Private forest enterprise has received only little attention in scientific writings (Tähtinen 1930 SF 14, and v. Julin—Lönngren 1936 YMV), but on the other hand, the development of forest industry has been depicted in large volumes (Meinander 1945 and 1950, Solitander 1930, Susitaival 1950).

Reports on the activities of the Forestry Association of Finland and the Society of Forestry in Finland (Heikel 1927; Cajander 1917 AFF 7; Lakari 1920 AFF 14; Laitakari 1930 AFF 36, 1933 AFF 38, 1934 AFF 40, 1935 AFF 42; Aro 1938 AFF 47), the former ones of which go as far back as to 1877, form valuable material for the future study of the history of Finland's forestry, as well as the anniversary publications of numerous associations, institutions, and enterprises.