THE SCIENTIFIC FOUNDATION OF FORESTRY

as exemplified chiefly by Forest Research Work in Suomi.

by

A. K. Cajander, D. Ph.

Director-General of the Board of Forestry in Suomi.

I had the honour to receive in December last a letter from the Committee appointed for the International Congress of Plant Science inviting me to lecture before the Forestry Section on the subject »The Scientific Foundation of Forestry as Exemplified by Forest Experiment Station Work».

In setting out to deal with the suggested theme, I may remark that I have been compelled to abridge and to reshape to some extent the subject set me. The fact is that my present duties, which are chiefly of an administrative and practical nature, have prevented me from following the work of the forest research institutions in different countries with that attention to detail which would enable me at this moment to deal with all the main lines taken by such research. In abridging the theme of my paper, I will therefore, with your permission, restrict my remarks, for the sake of greater concreteness, chiefly to the work done in Suomi in the field of forest research and to the results obtained there. As far as possible, I shall attempt, however, to keep on the whole to those matters which, *mutatis mutandis*, might be regarded as possessing a special significance also for North American forestry.

In point of fact, between Suomi and North Europe in general on the one hand, and North America on the other, certain notable similarities can be said to exist. A similar so-called Fenno-Scandian climate to that of Suomi and Scandinavia prevails over immense areas in the interior of Alaska, the interior of British Columbia, Alberta and the Rocky Mountains of the United States, in part right down to the Mexican frontier, though naturally at an increased altitude the farther south we proceed. A similar climate, generally perhaps some-what moister, also prevails over wide areas in North-East Canada and the mountainous districts farthest to the north-east in the United States. Just as in Fenno-Scandia, glacial moraines, eskers and sands hide the basic rock, so, in North America, we find glacial formations over wide areas. The swamps, too, which in Fenno-Scandia are so numerous that in Suomi, for instance, they comprise 35.7 per cent of the total land-area, appear in great number and extensive form especially in Canada. North American forestry is as little tied to old traditions and the rigid forms of old-established forms of management as that of Suomi, so that in each case the future of the forestry can be planned with comparative freedom, but in each case, alike in North America and North Europe it is obviously of the utmost present importance that *forestry be planned on the most rational lines on the basis of sustained yield.*

Among the investigations carried out in Suomi, the materialization of which would appear to possess a significance also for the planning of North American forestry — to begin with, perhaps, in one state, or a few states only — I would mention the recently completed survey by lines of the total forests of Suomi, the chief features of which are possibly familiar to members of this Congress. Suomi has certainly — except for a few of the most northern districts and the Petsamo area obtained from Russia by the Peace of Dorpat in 1920 — been mapped throughout by the Survey authorities, but as the surveys have been carried out during different periods and supplemented at different times, and the boundaries between forest, swamp, meadow and ploughland have had ample time to alter considerably during the course of one and a half centuries, any inventory of the Finnish forests based on survey maps was doomed beforehand to unreliability. On the other hand, a detailed inventory of this nature over the whole country would have been much too expensive. In the circumstances, recourse was had to what is called surveying by lines, a method much applied of old in North European countries, and used, for instance, in the mapping, during the past fifty years, of the State forests in North Suomi. The survey by lines of the total forests of Suomi was made in such fashion that the lines, placed at regular intervals of 26 kilometres, were drawn beforehand on a map of the country, in a direction at right angles to the main ridges and the main trend of the waterways. On each line a complete survey — comprising soil, productivity class (forest-type), species, age of stand, height, standing crop, growth, silvicultural state of forest, etc.—was made of the stands met with along the line, each stand separately on its own form, together with a measurement of the length of survey line occupied by the stand; corresponding measures were resorted to for swamps, meadows and ploughland. To keep down expenses, actual measurements of trees were not made all along the line; ocular estimates were made of all the stands met with, and at regular intervals, at the end of every other kilometre, a sample plot of 50 × 10 metres was taken for measuring the standing crop (cubic metres per hectare) and growth, and a plot 100 × 10 metres for measurements of merchantable timber (over 20 cm at breast-height). Where a sample plot would have comprised the boundary areas of two separate stands, it was automatically transferred to the stand with the longest length of line within its area. As these sample plots were invariably subjected to previous ocular estimation, it was possible, by using a method of calculation specially devised for the purpose, to calculate the correlation between the estimation (standing crop per hectare) and the results of actual measurement, and thus to check ocular estimation all along the line; further, the sample plots provided in themselves a wealth of valuable control material for the ocular estimation statistics checked in this way — the total number of sample plots amounting to 4,919. In addition to its comparative cheapness, the method used in this case has the inestimable advantage over, say, the kind of survey in which every tree along a line of, for instance, 10 metres breadth is measured, in that the survey of fairly extensive areas can be completed by its use in a comparatively short time; the method has also greater accuracy to commend it, as a plot of 50 × 10 metres or 100 × 10 metres can be much more exactly defined than a sample plot 10 metres broad with an actual length equal to that of the whole line; it must be remembered that the standing crop of the sample plot is decisively affected by the accuracy with which the sample plot is defined, in other words, by the measure in which trees growing on the boundary are included in the plot. — As in the method used, the part of the line, falling within each stand, swamp, etc., had been exactly measured in a longitudinal direction, and all the necessary calculations for each stand, etc., registered, it was an easy task to calculate, from the resulting statistical material of over 100,000 memorandum forms, the percentages of the various classes of land (forest, swamp, meadow, ploughland, etc.), the percentages of different soils, the percentages, as regards forest, of the different forest-types, the different species of trees, the different age-classes and in these the stands of varying standing crop, the percentages of different silvicultural state (state of nature, tended, devastated, etc.), and other ratios for the whole country, for the various provinces, the various water-systems, phytogeographical areas, etc., and as the superficial measurements of all such areas are given in geodetic maps, the corresponding ratios could be calculated also in absolute measurements. The outdoor work was chiefly done during two summers, and the cost worked out at 0.00043 dollars per hectare of land-area in the whole country. Mathematical-statistical calculations and control-measurements over smaller areas along lines set closer together showed the spacing of the lines to have been adequate; a more closely-set system of lines would only have raised the cost considerably without appreciably affecting the accuracy of the results. If the area to be inventoried is larger than Suomi (34.4 million hectares) and large sub-areas will suffice, the lines can, of course, be placed farther apart in proportion, with a corresponding decrease in costs. — This kind of careful inventory of forest resources and the state of forests is obviously of extreme importance. It provides a reliable foundation on which the whole forest policy of a country in its most important aspects can be based.

To procure the full benefit of a survey by lines of this nature, which must naturally *be carried out in so short a time that the material is in its entirety, either in respect of the whole country or the area selected for survey, of a homogeneous nature as regards age,* certain preliminary measures are essential. By these I do not, naturally, mean so much the checking and the working-out of the methods used in measuring sample plots and individual trees, for in this respect the methods in general use provide, on the whole, sufficient guarantee. Nor do I mean the methods by which, on a mathematical-statistical basis, ocular estimates are verified, or the general working-out and application of mathematical-statistical methods to surveying by lines, as in this respect there are already in existence fairly reliable and exact methods, including some methods worked out quite recently in Suomi. I mean above all the creation of an objective principle of classification according to quality.

The necessity, from many points of view, for classifying sites on the basis of forestry is well-known. The productivity of different sites varies so greatly that no calculations as regards yield and profitableness can be arrived at before the conditions of productivity classes of the area in question have been elucidated. A classification of this nature is equally essential also from the silvicultural point of view, as the choice of species is decisively affected by the quality of the site, and even with the use of the same species the silviculture on sites of different quality will be totally different. For the various productivity classes to correspond from the point of view of mensuration, it is naturally not sufficient, however, as it is customary to do, to determine productivity classes separately for each species of tree. The forest-lands of a given area must be capable of being classified according to quality irrespective of the species of tree grown, thus making it possible, for instance, supposing the whole area in question were to be cut down or a change made in general in the proportion of different species, to procure for each site the species of tree which in the prevailing conditions would be most profitable for that particular quality of site. In other words, in drawing up, for instance, yield tables, a *common classification according to site quality should be applied to all species of trees,* in such a manner that a certain grade in respect of one tree corresponds exactly to the same grade for a second, a third, a fourth species, etc., as only on this condition is it possible to make comparative calculations as to the profitableness of different species on any site, the importance of this common classification increasing with the number of different species grown in a country. Obviously, too, the *classification for mensuration purposes should be identical with that for purposes of silviculture,* so that the use of different qualities of site for the same species, depending on whether silvicultural or mensuration considerations have been allowed to rule, is avoided. The only classification that fulfils all these conditions is a biological one, that is, *sites must be classified for purposes of forestry in such a manner that sites in the main of the same value, in a biological sense, are entered in one class, and those of different value in different classes.* In Suomi, as may be known, the means used for obtaining such a classification of productivity has been the division into so-called Forest Types. In this case all those stands are referred to the same forest type the vegetation of which at or near the time of maturity of the stands and provided the stands are normally stocked, is characterized by a more or less identical floristic composition and by an identical ecologico-biological nature, as well as all those stands the vegetation of which differs from that defined above only in those respects which — being expressions of differences due to age, fellings, etc., — have to be regarded as merely accidental and ephemeral or at any rate as only temporary. Permanent differences call forth a new forest type in cases where they are sufficiently well-marked, or a sub-type in cases where they are less essential, but, nevertheless, noticeable. The investigations of YRJÖ ILVESSALO (1920) have shown that the goal aimed at is really attained as regards mensuration, and those of LÖNNROTH (1925, 1926) have in a brilliant manner confirmed this result. The investigations of VALMARI (1921) and AALTONEN (1925, 1926) have supported these results from the standpoint of the science of soils, and those of LINKOLA (1924) from the point of view of plant-biology, while silvicultural investigations, too, have led to the same general results. — For the survey by lines of the forests of a country it is in every case essential that the principle of classification of sites according to quality is defined beforehand as exactly and as objectively as possible. It is further of *extreme importance that in drawing up growth and yield tables for the chief tree-species of a country, the same principle of classification is used as in the survey by lines*, in which case it will be possible, amongst other things, to estimate with full objectivity the extent to which the yield of the country's forests can be raised by growing on each site the species most profitable on that site and by expending on this species the tending demanded by it.

In areas where swamps prevail to any considerable extent, it is naturally not enough, even from the point of view of forestry, to restrict attention to the forests, but the swamps, too, must be investigated. A quite appreciable proportion of swamps are such that, when drained, they can be made to produce fully satisfactory forest. Of the Finnish swamps, for instance, about 40 per cent are drainable for forestry purposes. In the measure in which the forest-area diminishes, particularly as land is brought under the plough, it will be necessary to have recourse to the reserve of forest-land represented by the swamps and to begin adding to the area of productive forest by draining these. As, however, the potential afforestation value of different kinds of swamps varies considerably, the necessity for a reliable classification of swamps according to their afforestation capacity becomes apparent. Swamps have been classed in Suomi for this purpose, using vegetation as a basis in this case, too, into so-called swamp types, and as a matter of fact, the investigations of TANTTU (1915) and MULTAMÄKI (1924) have shown that after ditching, the various swamp types tend towards definite forest types, becoming finally transformed into these, if the ditching has been effectual, in which case they display in the main a growth as good as that of the corresponding forest types on mineral soil. To obtain the full benefit from surveying by lines the principle of classification of swamps from a forestry point of view must be biologically defined beforehand in such a manner that it will subsequently be possible to calculate from the survey the amount of swamps available for ditching, and the extent to which the different afforestation-capacity classes are represented in these.

A survey by lines permits, further, of as accurate an inventory being made of m e a d o w s, f i e l d s, etc. as of forests and swamps, and it is indeed worth while, even in a survey intended to serve purely forestry purposes, to classify at least roughly fields and meadows, too, and similarly to classify swamps also in respect of their suitability for agricultural ends, from the point of view of the fuel and peat industry, etc., but it is obvious that the labour involved will be heavier and the main purpose suffer in proportion as tasks not directly connected with a forest survey are included.

It is worth mentioning, however, that by following the method of classification according to quality used in Suomi, namely, the classification of forest-land into forest types and swamps into swamp types, an incidental result of the survey by lines is the attainment of extremely important information, from the point of view of settlement policy, regarding the f e r t i l i t y o f d i f f e r e n t districts. Thus, by calculating for each kilometre of line the percentages of the most productive — or, we might say, the most exacting — forest types, the next best, and so on, one obtains, particularly if attention is paid, too, to soils (and the degree of stoniness), an exceedingly illuminative, comprehensive and objective picture of the degrees of fertility of different districts and consequently of their possibilities for prospective settlement.

From the standpoint of forestry a survey by lines is still not in itself sufficient, but must be supplemented by a study of f o r e s t c o n s u m p t i o n in which attention must be paid both to the average losses due to accidental causes — forest fires, storms, insects, etc. — and to consumption for domestic and industrial purposes as well as to possible exports of unworked timber. In order to establish in a fully satisfactory manner the balance between growth and consumption it is essential for the *survey by lines and the investigation of consumption to be carried out as nearly as possible simultaneously.*

For my own part I am therefore prepared to assert that the inventory of forest resources and forest growth by lines provides excellent material for placing a country's forest policy, and in part also its agrarian policy, on a right footing. For it to answer its purpose fully, an inventory of this description calls, however, for important preliminary labour, above all the establishment of the classification of forest and swamp lands according to quality on a coherent and objective basis for the whole area of investigation, and no less for important parallel labour, namely, the drawing-up of growth tables for the chief species of trees, using the same quality-classes for all species. At approximately the same time as forest resources are inventoried, the rate of consumption should be investigated, to permit of the striking of a balance between growth and consumption, for the whole country and for the various districts separately.

I will now beg your permission to deal more closely with questions appertaining to silviculture.

It cannot be denied that at present there is often too much of a schematic spirit in silviculture and that the tending of forests is arranged in great part to suit preconceived opinions. The different schools can hold sharply divergent views; often one can speak outright of fashions in silviculture. Sooner or later, however, the too schematic tending of a forest is bound to be avenged; you cannot with impunity treat forests in a cut-and-dried manner. It is wrong to ask yourself: are forests generally to be regenerated by sowing or planting or by natural regeneration; are forests to be cut in compartments or by selection; is organization to be based on large or small stands; are forests to be grown pure or mixed, etc. The one alternative will be right in some conditions, the other in others.

The sowing, planting and cutting methods, etc., now in use, are undoubtedly in themselves suited on the whole to their various purposes. In other words: the actual methods of forestry are in the main satisfactory as methods; although, particularly as regards thinnings and selection cuttings, there is without doubt room enough for further development. All the more important, *therefore, is it to be able to judge correctly which of the silvicultural methods is the most favourable in the circumstances.* Here one cannot allow the »practised eye» to decide unaided, for it is too often mistaken, and it is probably still more dangerous to leave the decision to the dogmas of the various schools. *The choice of the right silvicultural method in each separate* *case* — and is not that the chief aim of practical forestry? — *demands a comprehensive knowledge of the life and biology of the forest.* The practised eye must not be allowed to decide blindly, but *the decision must be left to a practised eye schooled both in economic and in biological knowledge.* In proceeding I shall touch only upon the latter, the biological side of the matter.

A person entrusted with the tending of forests, or one who superintends the tending of forests, should know how a forest reacts to any of the measures applied to it. Such knowledge is, however, as yet only partly available to anyone. Before the practised eye can be adequately educated in this respect, an intensive work of investigation in forest biology must be undertaken. This comprises:

1) a comprehensive inquiry into the biology of the various species composing the forest: an inquiry into their seed-production in different circumstances, their capacity for throwing off shoots in different circumstances, the rates of growth in different circumstances, their need for light, their capacity to withstand frost, etc.;

2) an inquiry into the biology of the standing crop, separately for each species of any economic significance, an inquiry into their natural thinning and the resulting division of the individual trees into development (canopy) classes and the development of these classes, as regards both their roots and their trunks and crowns, the relation of different species to each other in the same stand, etc.;

3) an inquiry into the biology of the entire vegetation of a stand: into the part played by weed vegetation in regeneration areas in general, and separately for the various species composing it, into the influence of undervegetation on the thriving of a forest in its later stages, its influence on the transformation of forest-land into swamps, etc.;

4) the significance of destructive fungi and insects in different conditions; and

5) the significance in different conditions of the microbiological flora and fauna of forest-land.

Despite the investigations already made, much additional investigation is still needed in the normal climate of stands in different conditions as compared with the general meteorological climate, in the normal formation of humus and the general formation of soil in forests in different circumstances, in the influence of different cutting methods and other silvicultural measures on the climate of a stand and on the normal condition of its soil, and in the consequent reaction of the latter on the vegetation of a forest as a whole and separately in the reaction on the development of the standing crop. *In all these investigations it is not sufficient to establish only the correlation between different phenomena, but the investigator must strive to understand them in their physiological or biological implications.*

It is my firm belief that silviculture is in essential need of this biological foundation, which — need we deny it — still, despite the copious investigations already carried out in these fields, only exists incompletely, and is only to be achieved by the most intensive investigation work. It might, perhaps, be remarked that the conditions in forestry are still on the whole so extensive in nature, that this kind of biological foundation is unnecessary. This I am inclined gravely to doubt. *It is above all in extensive conditions that results have to be achieved with the minimum of expenditure.* And how is this to be possible, unless the forester working in such conditions knows how a forest will react to every, even to the least costly, measure? *In silviculture, even the profoundest knowledge and inner perception of forest biology is surely not unnecessary, still less an obstacle, provided, of course, it has not been attained at the expense of practicality.*

We have become accustomed in forest investigation work to rely to a great extent, often to the greatest extent, on experimental methods — do we not generally term forest research institutions »forest experiment stations»? In the field of silviculture we have, however, in my opinion, greatly over-estimated the significance of experiments—owing, perhaps, in some measure to the close connection with agricultural investigation work. Yet in inductive scientific research there is the comparative method to resort to as well as the experimental. Forest experiments have the general drawback that owing to slow growth and the high age reached by forests they need extremely long periods to lead to definite results. Against this, fully reliable results can be obtained much more quickly by comparative methods. *For forest in its natural state and forest being managed contain an unlimited number of objects of investigation ready to hand; the investigator must only know how to choose the most instructive of these for his particular purpose at the time.* Such observation stands or fractions of stands do not, it is true, fulfil the highest demands in every respect, but the number of them is so great that the effect of disturbing influences can be largely eliminated. The biological investigation of forests in particular should be, to quite a decisive degree, based on comparative research in nature, as it is frequently absolutely impossible to bring about the desired conditions artificially by means of deliberate experiments, and in the latter case the investigator has very often had time to die long before the experiment has reached the required stage. This is by no means to be taken as implying that is unnecessary *to supplement and complete comparative research by actual experiments.* Indeed, experiments can be arranged to much better purpose, if the matter in hand has previously been sufficiently elucidated by comparative research; all that I mean is that in my opinion the experimental work should not be placed in the foreground. Thus it is my opinion that *silvicultural-biological research in particular should at least for the present be based chiefly on the material held out by natural and managed forests in themselves.* This applies in a greater degree than to Suomi, as far as I can see, to North America, where the proportion of natural forests is still so immense.

In comparative research of this nature it is naturally essential that the trees, groups, stands, etc. compared are truly comparable. Here we are faced again with the question of the appropriate classification of afforested sites according to quality, a classification, in effect, in which sites of equal value from a biological standpoint are really grouped together and those of different value kept apart. Whether the subject of research concerns the sparsity or density of growth; the influence of one species or another, etc.; on, for instance, the formation of humus; or let us say the microflora of the soil; all comparisons and the results derived from these will be found to halt, if the stands concerned are not situated on sites of biologically equal value. The exact classification of sites is essential not only for the objective treatment of comparative observations — or for that matter of experiments — but it is equally necessary for the right utilization of the results. The application of the results in practice presupposes in the applier exact knowledge of the general conditions and in particular of the kind of site on which the results were obtained.

This leads speculation a step further. Many silvicultural textbooks and manuals contain a special department devoted to »a p p l i e d s i l v i c u l t u r e». By this is chiefly meant the silviculture of different species of trees. Nevertheless, the duty of applied or, more rightly, s p e c i a l i z e d s i l v i c u l t u r e cannot be merely to give an account of the silvicultural care of different species, because, as already mentioned, even the tending of the same species must be arranged in a totally different manner for different sites. Thus, the site is fairly decisively responsible for the choice of the natural regenerative method, the method of thinning, etc., for the nature of possible growing of standards or growing of underwood, etc. *The silviculture must be arranged to conform to the demands of the site, which leads inevitably to the conclusion that specialized silviculture must, above all, comprise the silviculture of different qualities of site, of biological productivity classes.* The whole of the forest-biological research referred to earlier has thus, in a quite decisive degree, to be directed to the comprehensive elucidation of the life and vital demands of different biological productivity-classes. From an extremely theoretical starting-point we have thus arrived at an eminently practical aim, for with the elucidation of the silvicultural care of each of the chief biological productivity classes, we shall be in a position to give the practical forester exceedingly concrete directions for different eventualities. It means — if the lines staked out by forest research in Suomi are followed — *that what has to be worked out is above all the silvicultural care of different forest types, which would thus form the chief subject of applied silviculture.*

Passing by many other important fields of research, such as the question of the cultivation of tree-species outside of their natural areas of distribution, of the geographical species of trees, the deterioration of forest-land into swamps and its prevention, the afforestation of swamps and open lands in general, and many others, I beg your permission to refer, before concluding my lecture, to a certain formal aspect of forest research. As in biological research in general, the results arrived at in forest research work are not as a rule as absolute as they can be, for instance, in chemistry or physics, the degree of variation in the properties of the objects to be observed being usually fairly wide. The results are mostly in the nature of an average struck from numerous more or less variable observations or measurements. In this case there is seldom recourse to exhaustive statistics, and one has generally to be satisfied with measuring or otherwise observing a larger or smaller number of individual cases, in other words, one has to rely on representative statistics. Such being the case, it is, of course, essential in working with statistical material of this nature to adhere closely to the methods generally approved for representative statistical research, that is to say, a wide use must be made of mathematical statistics. This is as essential to the drawing-up of volume and growth and yield tables as it is to the treatment of line survey statistics, to the elucidation of the interior construction of a stand and its development and to the investigation of the vegetation of a stand. Without the checking and control provided by mathematical-statistical research methods, the results of the most careful research work based on representative statistics can be of doubtful accuracy. And as we all know, for practical purposes the accuracy of the results arrived at in research is a prime consideration.

The science of forestry must serve practical forestry. It must be capable of providing practical forestry with the most practical weapons in an easily utilized form. Yet this does not imply that the methods of research should also be simple and easy to apply. From the history of silviculture one could quote exceedingly illuminating examples of the application of »practical methods» to research work, or in other words, of attempts that have been made to investigate complicated matters with inadequate preparation and insufficiently exact and reliable means of investigation, with the result that the outcome of such research was of as little practical use as it had scientific value. For a person using a telephone it is altogether immaterial to know how complicated were the processes that went to the invention of the telephone; for him the main thing is that the telephone he may chance to use or own works properly and that it is easy to look after and to use. Similarly, it is nothing to the forester engaged in practical work, how laboriously any of the results of the science of forestry have been attained; the chief thing for him is that the result is reliable and that it can be applied without difficulty to practice. *In spite of the fact that forestry is an eminently practical field, the worker in the science of forestry may not be deterred even by the most difficult and complicated methods of research, if reliable and practical results are not to be achieved in any other way.* The guiding principle of scientific forest research might be formulated thus: *scientifically valid methods of research, but purely practical aims.*

Suomenkielinen selostus.

Metsätiede perustana metsätaloudelle,

silmällä pitäen etupäässä Suomessa suoritettua metsätieteellistä tutkimustyötä.

Suomen sekä yleensä Pohjois-Euroopan toiselta puolelta ja Pohjois-Amerikan välillä toiselta puolelta on, suurilla alueilla, melkoisia yhtäläisyyksiä yleisissä luontosuhteissa ynnä myös siinä, että on mahdollisuuksia olemassa verrattain vapaasti, aikaisempien traditsioiden sitä estämättä, järjestää metsätalous luonnon- ja taloudellisten ehtojen mukaisesti. Sen vuoksi metsätieteellisessä tutkimustyössäkin voidaan suureksi osaksi noudattaa samanlaisia menettelytapoja molemmissa maissa.

Tärkeimpiä Suomessa suoritettuja metsätieteellisiä tutkimustöitä, jotka saattavat tulla kysymykseen Pohjois-Amerikassakin, on metsien linjoittainen inventtaus. Vallankin siinä muodossa, jossa se on Suomessa toteutettu — silmävarainen puumäärän, kasvun y. m. arvioiminen pitkin määrävälimatkan päässä toisistaan olevia linjoja sekä tarkkojen koealojen otto määrämatkan päässä kullakin linjalla — soveltunee se hyvin Pohjois-Amerikassakin käytettäväksi. Jotta linjoittaisesta inventtauksesta olisi täysi hyöty, täytyy olla etukäteen olemassa objektiivinen kasvupaikkojen luokittelu — Suomessa sellainen, kuten tunnettu, toimitetaan metsätyyppien avulla — ja tärkeätä on lisäksi, että on olemassa samaan luokitteluun nojautuvat kasvutaulut, jolloin saadaan selville myöskin, minkä verran sopivalla puulajin valinnalla ja yleensä asianmukaisella metsien hoidolla voidaan niiden tuottoa lisätä. Jos samanlaisin perustein, kuten Suomessa on tehty, luokitellaan myös suot ja on tutkimuksilla selvitetty, mitä tuottoluokkia eri suolaadut ojitettuina edustavat, voidaan selvitellä, minkä verran saadaan eri tuottoluokkiin kuuluvia metsämaita lisätyksi soita ojittamalla. Johdonmukaiseen kasvupaikkaluokitteluun nojautuen voidaan linja-arvion perusteella lisäksi saada selville viljavan maan jakaantuminen ja siten saada tärkeä perusta asutuksen ja uutisviljelyksen suunnitteluille. Jos metsävarastojen ja kasvun inventtauksen ohella selvitellään myös metsien kulutus, niin saadaan selville bilanssi kasvun ja kulutuksen välillä, mikä on erinomaisen tärkeä maan metsäpolitiikan suunnittelulle.

Toisen tärkeän tutkimustehtäväryhmän muodostavat metsien hoitotapojen selvittelyt. Metsien asianmukainen hoito edellyttää välttämättömyydellä metsän elämän, sen biologian, kaikinpuoleista ymmärtämistä. Siihen tarvitaan siis mitä monipuolisimpia metsäbiologisia tutkimuksia. Tällöin ei ole ensi kädessä turvauduttava kokeisiin, vaan ennen kaikkea ja varsinkin Amerikassa, jossa metsät vielä suuremmassa määrässä kuin Suomessa ovat luonnonmetsiä, on käytettävä vertailevaa tutkimustapaa. Koska metsien elämä ratkaisevasti riippuu kasvupaikan laadusta, täytyy metsänhoidon hyvin oleellisesti mukaantua kasvupaikan laadun (metsätyypin) mukaan; kasvupaikkaluokat tulevat siten muodostaneeksi sovelletun metsänhoidon perustan.

Metsätieteellisissä tutkimuksissa eivät tulokset yleensä ole yhtä absoluuttisia kuin esim. kemiassa ja fysikassa, vaan saavutetaan ne yleisesti keskiarvoina toisistaan enemmän tai vähemmän eroavista mittauksista tai havainnoista. Näissä tutkimuksissa täytyy niin ollen mahdollisuuden mukaan noudattaa edustavassa tilastotutkimuksessa yleensä hyväksyttyjä menettelytapoja. — Yleisenä ohjeena metsätieteellisessä tutkimustyössä on oleva: tieteellisesti pätevät tutkimusmenetelmät mutta puhtaasti käytännöllinen päämäärä.