According to modern theories, irrigation should in many cases be combined with drainage. The drainage requirements should be based on the soil properties, the salt content of ground water and irrigation water, and the geo-hydrological characteristics of the area.

In France there is now a tendency to employ soil maps when preparing irrigation schemes. The first requirement is maps showing the suitability of the soils for irrigation. As a result, irrigation projects are now being adapted to soil conditions.

The French group recommends the study of soil conditions in existing irrigation schemes. This is a very important suggestion. Once the effects of irrigation on the soils are known it is easier to forecast the results of irrigation in new schemes.

In Greece large tracts of land have been studied according to the system of classification used by the U.S. Bureau of Reclamation.

In Portugal no irrigation project has been carried out without a previous soil survey since 1926. From these soil maps is derived an interpretative map showing the suitability of the soils for irrigation. These soil surveys are undertaken by soil scientists employed by the National Irrigation Board. The areas studied by this group are selected with reference to the soil maps compiled by the National Soil Survey.

In Turkey classification activities carried out according to the system of the U.S. Bureau of Reclamation are rapidly increasing as the construction of water storage dams progresses and irrigation is found to be necessary for obtaining higher yields.

In Spain soil surveys of irrigation schemes are beginning to assume importance.

2.7. RESTORING LAND TO AGRICULTURE AFTER MINING OPERATIONS

In the United Kingdom and Germany soil survey groups have successfully helped in restoring land after open lignite, coal or iron mining operations. In the United Kingdom it has been found that the productivity of such restored land is less than that of undisturbed land. Field drains subside; compaction causes failure of the early growth of crops and grass. Investigations of restored sites with these and other points in mind have enabled proposals to be submitted and regulations drawn up regarding the methods of restoration to be adopted.

Unsightly and unproductive land has often been made almost as productive as it was before the mining operations begun.

In the extensive lignite area in the Rhineland district of Germany the productivity of the land depends on the loess deposits and the soils developed on it. A careful inventory (1:10,000) has been made of these loess deposits. After the lignite has been excavated the loess material is used to restore the land. The loess inventory is made for this purpose.

2.8. RECONSTRUCTION OF AREAS DAMAGED BY FLOODS

In Belgium and the Netherlands soil maps have proved useful for the reconstruction work carried out after the flood disaster of February 1st, 1953. Thanks to the soil
maps it was possible to make a rational sampling of the soils for laboratory analysis in relation to the dosage of gypsum. Where the land was covered by marine sand the soil map gave the necessary information on the possibility of ploughing-under the sand. Where the damage was extensive a new settlement plan was necessary and the plan could be based on existing soil maps.

2.9. RECLAMATION OF WASTE LAND AND SOIL IMPROVEMENT

In the densely populated parts of western Europe little wasteland has been left which could be reclaimed for agriculture. But even in Belgium it has been possible to start reclamation projects on wasteland after the soil surveyors had studied the district.

In Norway land suitable for reclamation has been studied by the Soil Survey and by the Norwegian Bog Association.

Where there are considerable areas of wasteland, soil surveys might be very useful for locating land where reclamation would be successful and for assembling the data required for the preparation of a reclamation plan.

Much land is in use of which the soils are of a fairly poor quality. The farming population of such areas is usually very poor and they are unable to improve their condition by applying modern techniques.

Situations such as these are intolerable in a modern welfare state. The areas should either be abandoned by agriculture or their soils improved.

The part played by soil improvement in modern farm consolidation projects has been discussed earlier in this chapter. Drainage is another soil improvement measure we have discussed above. Other methods are the mixing or interchanging of soil horizons and the breaking of hardpans.

In Belgium and the Netherlands acid marine soils are improved by deep ploughing (up to more than 1.50 m) thereby bringing up to the surface subsoil material rich in lime.

It will be obvious that soil improvement should be based on a detailed soil survey.

2.10. SOIL CONSERVATION

In the temperate moist parts of western Europe soil conservation, in the sense of protection of the soils against soil erosion, is not considered to be a serious problem, although it would seem that there was fairly active soil erosion in the 17th and 18th centuries.

Important research work on soil erosion and conservation has been carried out by Prof. Dr. H. KURON of the Soil Science Institute of the University of Giessen (Germany). In the German hill districts the arable soils have undergone important changes since the land was reclaimed. Modern farm consolidation methods tend to lay out large fields and this creates new soil erosion hazards on sloping land. In the studies of Professor KURON five types of hazards are distinguished and soil conservation methods are adapted to this classification.
In Greece the soil capability classification of the U.S. Soil Conservation Service has been applied in several places. Land use has been adapted to the findings of these surveys.

In Portugal a soil survey has been completed of the southern part of the country which has a Mediterranean climate and serious erosion problems. A Land Capability map is also being published. This clearly indicates the main soil conservation problems.

Both maps have drawn the attention to problems requiring investigation and some soil conservation research work is already being carried out. Several soil conservation projects now in progress are based on the soil map and the Land Capability map. In Portugal the Director of the Soil Survey is a member of a group in charge of studies on protection from soil erosion of the watersheds, including areas to be irrigated.

The importance of soil and water conservation is well recognized in Turkey. Activities in this sphere are based on examples and experiences of the U.S. Soil Conservation Service. Land capability maps have been compiled at many places and the results applied to numerous reclamation schemes. In the Mediterranean area bare limestone slopes can be terraced and economically planted with olives or other perennial crops. Water conservation is at least as important as soil conservation, since under the prevailing conditions water is the minimum factor in crop production. Many other activities, usually designated in the U.S. as soil and water conservation, are also being tried out in Turkey.

There are some other Mediterranean countries in which no soil surveys are being undertaken, despite the importance of soil erosion.

REFERENCES


3. SOIL SURVEY IN RELATION TO TOWN AND COUNTRY PLANNING

In most European countries the soil survey groups have important duties in connection with Town and Country Planning. These countries have a rapidly expanding non-agricultural land use; land is required for various purposes (towns, industries, airports, military authorities, recreation, highways, natural reserves) and in many cases agricultural land will have to be given up.

An interpretative map for both agricultural and non-agricultural land use, derived from a detailed soil map, can be used as a safe guide by the authorities who decide on such changes in land use.

As far as concerns horticultural land and agricultural uses, soil suitability classification maps of the kind discussed in chapter 2.2 and 2.3 of this report will specify which land is valuable for horticulture and farming. Maps showing the suitability of land for non-agricultural uses can be derived from detailed soil maps after consultation with soil engineering experts and other technicians.

Since the loss of good land has serious consequences to agriculture attempts should be made to locate urban and other non-agricultural sites on poor agricultural land. In some cases this can be done.

In Belgium and the Netherlands some agricultural land is too dry for optimum production, although the same land is excellent for building development. It is not always possible to find such a good solution, but with the interpretative maps available the authorities can make the best possible decision under the circumstances.

It is interesting to note that this application of soil surveying has had a different development in the countries concerned.

In Belgium the soil survey group works in close co-operation with the “Administration de l’Urbanisme” (Town and Country Planning Department) of the Ministry of Public Works. A number of reports have been published on important regions. One dealing with the Courtray region (in Flemish by ’t JONCK) first discusses the soil conditions.
of the region and the suitability of the various soils for agriculture and horticulture. Since the region is rapidly becoming industrialized the report contains an interpretative classification for building purposes. The report also gives an inventory of natural resources. Plans for the extension of towns and agricultural development projects including improvements in drainage and changes from ordinary farming to market gardening, can be safely based on studies as these.

Soil scientists have also made an essential contribution to the very interesting report entitled "Le plan d'aménagement de la région Liègeoise", published by the Town and Country Planning Department of the Ministry of Public Works. The Liège region is one of the most industrialized districts in Europe and it also includes areas of very productive land. The interpretative grouping of soils as worked out by the soil scientists and based on a very detailed soil map (1:5,000) enables the regional and national authorities to pursue an efficient land use policy and to safeguard agricultural interests on the very good soils.

In Finland it is fully recognized that country planning and knowledge of soils is generally needed for settlement, industry, traffic and land utilization. The lack of this knowledge may lead to errors which are impossible to correct at a later date. On the other hand without soil maps the planner is in complete ignorance of the land utilization possibilities of the district. Soil mapping in Finland has therefore been applied to all regional planning and all workers available for soil mapping are concentrated on these areas.

All culturable land should be saved for agriculture as there is plenty of land in Finland which is unsuitable for agriculture but quite suitable for other purposes.

In France the urgent need for information on soil conditions around the main towns was the main reason why soil surveying could be begun in a modest way. The chief aim of these surveys of the vicinities of towns is to ascertain the suitability of the land for agriculture so that new towns, industrial sites and other non-agricultural land could be sited with the least possible damage to agriculture.

The first 1:50,000 map was of the Paris district (350,000 hectares) where it was possible to safeguard the famous market gardening zones. The vicinities of other rapidly growing towns have also been surveyed, in all 180,000 hectares. It is estimated that about 50% of the work was of real importance.

In Germany similar work has been reported from the North Rhine-Westphalia region. The vicinities of many towns have been surveyed on scales of from 1:10,000 to 1:5,000. In addition to the soil map a hydrological map is compiled and a map indicating soil engineering data for building purposes (Baugrundplanungskarte).

One difference between this work and that done in other western-European countries is that the German maps essentially serve the town and its interests, and not agriculture. This is because the only areas considered are those which have in any case been lost to agriculture.

In the Netherlands the contribution of the soil survey group to town and country planning has been mainly to safeguard horticulture. About half of the Dutch horticultural
production is exported and horticulture is obviously just as important to the national economy as industry. Such products as hyacinth bulbs are even a world monopoly. Since only a very restricted acreage can produce such crops the land available deserves to be protected from other land users. Comparable cases are found in greenhouse districts as the Westland area, which is surrounded by big towns and the great port of Rotterdam.

The interpretative maps, based on detailed soil maps and indicating the suitability of the various soils for the crops in question, have drawn the attention of many authorities to the unique value of certain soils for the national economy.

Most horticultural centres have been surveyed in great detail and the relationships between the soils and the most important crops have been studied at the same time. Soil suitability maps are the essential results of this activity.

The vicinities of about 100 towns have been mapped in connection with plans for their development and this has always resulted in soil suitability maps. Wherever possible, agricultural interests have been safeguarded.

The important development plans for the ports of Amsterdam and Rotterdam have also been drawn up with the help of soil maps and interpretative maps. These have given the authorities a good idea as to the value of the land that has to be destroyed or can be saved.

The work discussed under this heading has become widely known in the Netherlands. It has become one of the channels viz. which soil survey work has gained in popularity and become a greatly respected profession for a soil scientist.

In Norway, where agricultural land is very scarce, discussions between town planners and soil scientists have recently begun.

In Portugal the soil survey group works in close co-operation (by means of soil maps, land capability maps and the giving of proper advice) with a number of town planning committees, viz. in Lisbon and other towns near the capital.

In the United Kingdom similar activities have been reported. A detailed survey, mainly for planning purposes, was made of the coastal district between the rivers Arun and Adur in West-Sussex. It is an area mainly consisting of first-class soils chiefly developed on brick earth, and this fact, combined with its high amount of winter sunshine, has led to its development as an important horticultural district. At the same time land is in great demand for residential and non-agricultural purposes, and as the survey was made in detail it should assist in formulating a land-use policy.
4. CONCLUDING REMARKS

It follows from the discussions in the preceding chapters that a soil survey institute should include the applications of soil surveys in their programme. It is not feasible to leave the applications entirely to outsiders.

It is very useful to both parties that there should be a close connection between the basic soil survey and classification and the applications. Soil classification now moves in the direction of a much more accurate morphological definition of soil units. This development will serve the applications. Moreover, modern methods of compiling soil maps and legends can be usefully adapted to the needs of the applications.

It is a disadvantage if the applications have to be developed without the support of a strong soil survey group. In this case the application will soon suffer from a lack of experience in modern soil science. On the other hand, soil survey groups not interested in applications will suffer as well. Soils can be studied as subjects without reference to their environment, but one of the most inspiring aspects of soils is that they bear a vegetation. If this vegetation is composed of an economic crop, the soil student also touches on economic problems of the kind discussed in chapter 1.3. The whole complex of soils, crops and mankind should be the subject of inspiration to soil surveyors.

Some will excel in theoretical aspects, others in the more practical ones. It would be a tragic misunderstanding to think that these practical aspects are only secondary research subjects. On the contrary, they require a wide knowledge of soil science and a good understanding of the land-use problems involved. This is equally necessary when the soil scientist has succeeded in obtaining the close co-operation of specialists in other branches of agricultural science or engineering.

Soil survey groups should maintain the closest possible connections with other agricultural research bodies. Part of their research programme should be a joint programme with other institutions. Good co-operation cannot be based on goodwill only but it must be carefully organized.

The branches of soil science discussed in this report form a rapidly advancing sector
of soil science. Soil survey groups cannot expect the agronomists, foresters, economists, engineers and other technicians who may use the soil maps to be familiar with this rapid progress. Soil survey groups should always be prepared to explain their work to those using their scientific results. In some countries soil survey groups organize special courses for the personnel of agricultural extension services and other bodies interested in soils. Although this work is very time-consuming and a strain on soil surveyors, the results are very rewarding as regards the application of soil maps.

Many European Agricultural Colleges have no facilities for instructing agricultural students in soil survey methods and results. This is one reason why soil surveying has not yet been started in certain European countries. This situation can be tolerated no longer.

The agricultural applications of soil surveys are so important that it is hardly possible to have a successful soil survey group that does not include associates with a background knowledge of agronomy.

In Germany the soil survey groups are sections of the Geological Survey Departments, owing to the interests of the survey work proper. This is an exceptional situation. In all other countries where soil survey work is in progress it is organized as a part of agricultural research. This can be recommended in countries where modern soil survey work has not yet been started.

The applications of soil survey discussed in this report are all related to agriculture. Other non-agricultural applications could have been mentioned, e.g. highway construction. This application is more highly developed in Michigan (U.S.A.) than in any part of Europe. The discussion of this and related subjects has been expressly omitted from the present report.