EFICS (European Forest Communication and Information System) – networked statistical and geo-referenced forest information?

du Breil de Pontbriand, L.[1], Flies, R.[1], Folving, S.[2], Kennedy, P.[2] & Päivinen, R.[3]

[1] European Commission, DG VI-FII.2, Brussels, Belgium
[2] Joint Research Centre, Ispra, Space Applications Institute, EMAP, TP 442, 21020 Ispra, Italy, sten.folving@jrc.it
[3] European Forest Institute, FIN-80100 Joensuu, Finland, risto.paivinen@efi.fi

Abstract

No common forestry policy has been implemented in the EU, therefore forest strategies and forest activities are dealt with in a rather dispersed manner within the European Commission. In 1989, EFICS (European Forestry Information and Communication System) was established via a regulation, which stated that the EC had to set up the system before the end of 1992; this date was later postponed. The objective of the EFICS is to "collect, coordinate, standardise and process data concerning the forestry sector and its development." The main work on implementation of the EFICS Regulation has been carried out in DGVI-FII.2 in close co-operation with other DG's, EUROSTAT and with international forest organisations. The Standing Forestry Committee and the EU Working Party on Forest Statistics have supervised this work. In 1995-97 the European Forest Institute (EFI) led a consortium which performed a major study on the user requirements for forest information and on the need for harmonisation of European forest statistics. The results of this study constitute an important base for the future development of the EFICS. The FIRS Project of the Joint Research Centre was established in 1994 to assist EFICS in analysing the possibility to use remote sensing (satellite and air-borne) techniques for providing geo-referenced data and information on the forest and other wooded lands of Europe.

Keywords: Forest information; Earth Observation

1 Introduction

Approximately 30 % of the European land surface is covered by forest, the exact figure depends on the definition: If all land covered by woody biomass is included, the figure probably will be close to 35 %, if only timber productive areas are considered the area is much smaller.

Traditionally, the assessment of the forest area and the quantitative and qualitative "description" of the forested areas have been of a statistical nature. National and regional strategic planning has been based on statistics. The local management, on the other hand, has been based on mapped information at large scale. The statistics have for many years served the needs for national and international information, as statistics can give rather precise estimates on the forest reserves and their productivity, and because the compilation of large scale maps is very expensive when large area coverage is required.

In the recent years, the explosive development in the needs for information on the environment has slowly started to create a shift towards the provision of geo-referenced national and international forest information. A single number, stating the total forest area of a country may be sufficient for strategic and economic planning, but, will be of very limited use in regional and environmental planning. The forests have, so to speak, moved from being a total private issue into being an important environmental planning and protection issue of general interest for the society. Since efficient regional environmental planning can rarely be achieved nationally due to the fact that most components needed in the planning are linked to landscape features, which are transboundary, then geo-referenced information has to be provided as generally available information, and preferably in a harmonised way, using a common nomenclature etc.

The development in the information needs goes hand in hand with the development in new technologies for data collection and data handling. In the case of forestry, remote sensing (RS) techniques and geographical information systems (GIS) have been very powerful instruments. The TREES (Tropical Ecosystem Environment Observation by Satellites) Project of the European Commission (Achard and D'Souza, 1994) which covers the tropical belt with small scale mapped information on the forest area is now developing into a tropical forest information system, and is slowly being developed into a global small scale forest cover map. A recent initiative by the G7 Committee on Earth Observation Satellites (CEOS) to establish a Global Observatory on Forest Cover (GOFC) as part of the International Global Observing Strategy (IGOS), constitutes a first step in the direction of providing global geo-referenced multi-scale forest information based on earth observation (EO) data, (http://lcluc.gecp.virginia.edu/strategies/strategy3.html/).

2 Forestry in the EU

Wood, was not part of the products in the list for common market policy

and regulations when the Common Market was created, accordingly no common forestry policy was established. However, in the early 60'ties a division for forestry was created in the Directorate General for Agriculture. This division is the main stakeholder in the forestry organisation within the European Commission, but also many other units and divisions deal with aspects of forestry, see Figure 1. This rather dis-

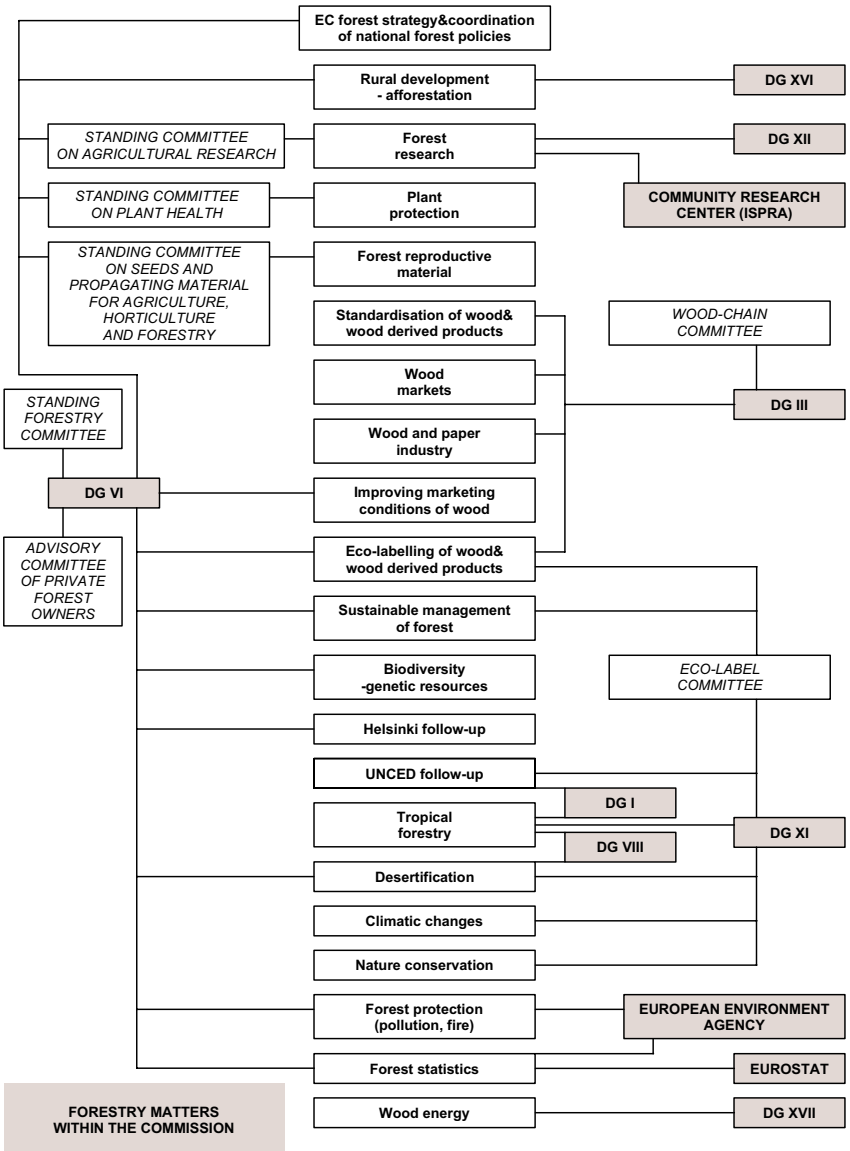

Figure 1. Overview of the main structure of the forestry activities within the European Commission.

perse responsibility clearly underlines that many different interests are linked to the forested lands of Europe, and clearly stresses the need for easily accessible and reliable information.

As no common forestry policy exists within the EU, the single Member States decide upon the type of forest information, which is made available for the general use within the EU. The Member States also decide the frequency with which the information is collected. The information on the European forest land is national, provided by the national forest inventories (NFI), and is generally available only for administrative units. This means that there exists a need for mapped forest information, which has not – and which will probably not be met in the near future by the same institutions unless both political and financial support is provided. It should perhaps also be realised that the present conditions stem from a time when forest was considered a national strategic issue, which may have created a degree of inertia in adjusting towards the needs of to day. This could be one of the major reasons why the whole forest sector slowly seems to be moving from the agricultural authorities to the environmental authorities – a process accelerated by the request for bio-diversity and sustainable development and the permanent monitoring hereof.

Except for the NFI's of the Member States, which of course are the foundations and corner stones of any EU forest information system, the major stakeholders of the Commission are:

DGVI – Forestry activities in relation to the Common Agricultural Policy, rural development etc.
DG I and DG VIII – Relations to forestry outside the European Union
EUROSTAT – Provision of European forest statistics
DG XI and the EEA – Forestry in relation to environmental protection
DG III – Wood and wood-product industry
DG XII and JRC – Research and development.

2.1 EFICS

The European Forest Information and Communication System (EFICS) was established in 1989 via an EU Regulation (CEE, 1615/89), which stated that the Commission had to set up the system before the end of 1992; this date was later postponed until the end of 1997. The objective of the EFICS is to "collect, co-ordinate, standardise and process data concerning the forestry sector and its development". It was stated that EFICS should "take account of existing data, and in particular statistics compiled by the statistical office of the European Communities, and shall make use of information available in the Member States, in particular data contained in national forest inventories, and of any database accessible at community and international level".

In 1996, the Commission realised that the actions undertaken so far to introduce the EFICS had been hindered by the lack of information on the various systems in Europe for the

collection and processing of forestry data, and not least the differences between them. Therefore, a study aiming at providing a comparative analysis of forestry inventory procedures in European countries was launched; this study should also provide a proposal, or alternatives, to improve the reliability of forest statistics at the European level. The study was carried out via a contract with a consortium led by the European Forest Institute.

The study clearly showed, and thereby confirmed the results of a study under the FIRS project (Köhl and Päivinen, 1996), that "The current situation is characterised by differences in inventory, sampling and assessment procedures, data sources utilised, nomenclature (e.g. measurement rules, definitions), models (e.g. volume estimation, estimation of growth components, forest structure), analysis techniques, inventory organisations and responsible bodies and inventory cycles. However, a system of international data collection, which makes use of national forest resource assessments, has some advantages. They are often based on sound statistical techniques, they provide representative data on both wood and non-wood products and services for an entire region or nation, and the costs of the assessment have already been covered by the individual countries. A high degree of expertise exists in the national bodies. These advantages encourage the search for methods integrating different techniques and to harmonise procedures and nomenclature, with the objective of compiling national forest resource information, and establishing a reliable and consistent data base at the European level." Furthermore "The EFICS-study found that there are clear needs for comparable information at the international level. This is due to the international initiatives originating from the RIO Global Convention. But also due to the needs of information of various private and public organisations in the member countries, as shown in the information needs assessment carried out as a part of the study". Further," EFICS is urgently needed to close information gaps concerning European forests and the forestry sector. It has potential to become a focal point of forestry in Europe and could have the capacity to provide the information on forests, their sustainable management and their environment, which is needed by different categories of users" (DG VI, 1996).

It was highly recommended on the basis of the above mentioned study that EFICS, together with the forest authorities of the Member States, among other things should guarantee reliable and comparable information at the European level. This could be achieved by harmonising methods and nomenclature, which would require both development of common conversion factors, but also new European definitions for certain key attributes assessed in the national forest inventories. In some cases, special EFICS surveys parallel to the national assessment could be a feasible solution. It should be taken into consideration that the application of remote sensing techniques could both facilitate the assessment, and provide harmonised

Europe-wide information. The storage of the data was not considered a major problem, the data availability is the main issue. The set up and configuration of the data dissemination and analysis facilities should be considered very carefully. Both flexibility data security and user requirements have to be taken into consideration.

2.2 FIRS

The FIRS project of the JRC was established in 1994 to assist EFICS in analysing the possibility of using both satellite and airborne remote sensing techniques for providing geo-referenced and statistical data and information on the forests and other wooded land of the Pan-European area (Kennedy e al.1994, 1995) (http://www.emap.sai.jrc.it/firs/).

The concept of the FIRS project is shown on Figure 2. The basic idea was, and still is to create a toolbox. The toolbox will provide the necessary information, methods etc. for extracting useful information from earth observation (EO) data, for combining EO data with other data types, for assessing accuracy, for using GIS techniques etc.

The internal structure for the FIRS project consists of several modules, Figure 3. The first foundation action, which was completed in 1996, has provided several data sets covering the Pan-European area at a small scale. These data are

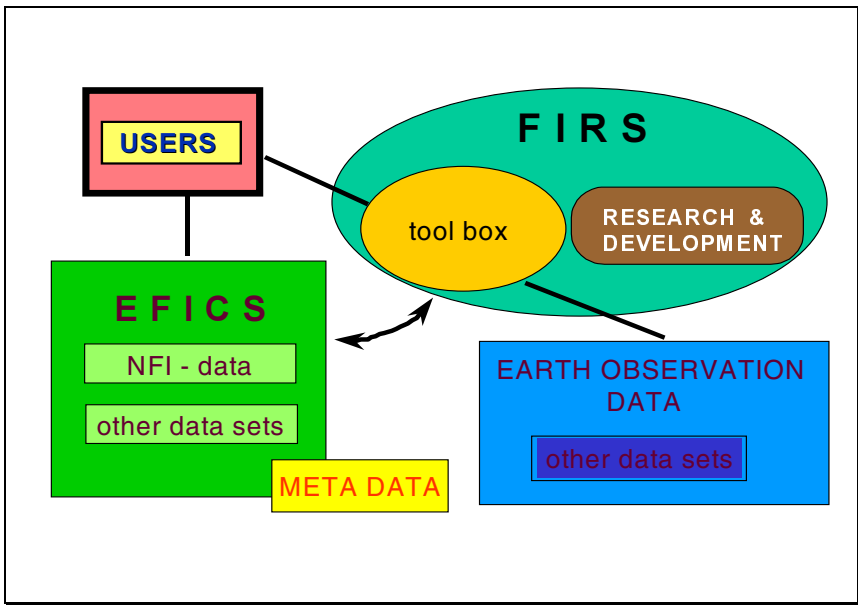

Figure 2. The role of the FIRS project is to assist EFICS in providing the necessary tools and methods for extracting useful information from earth observation data.

publicly available. The forest nomenclature study carried out by the European Forest Institute (Köhl and Päivinen 1996), is available on, (http://www.emap.sai.jrc.it/firs/). The third foundation action is continuously being supplied with new data from the various forest projects financed or co-financed by the Commission. Only some of the data from this foundation action will be publicly available. A steering committee under DG XII is looking into the problems linked to the publication of test area data coming from the various research and development share cost projects. As most data from test areas will be large scale, some data will be considered restricted, which may add some complications.

The software package, SILVICS, (McCormick, 1998; McCormick and Folving, 1998) developed in-house for forestry applications is publicly available. SILVICS is a user-friendly software package, which runs on most computer platforms, and which provides advanced techniques for the geometric and radiometric correction, structural and statistical analysis, and classification of multispectral satellite imagery. The software is freely available, under standard copyright conditions, on request to the Space Applications Institute's EMAP Unit.

Thus, the first part of the FIRS project has provided the very basic tools for the application of EO data within the frame outlined in Figure 2.

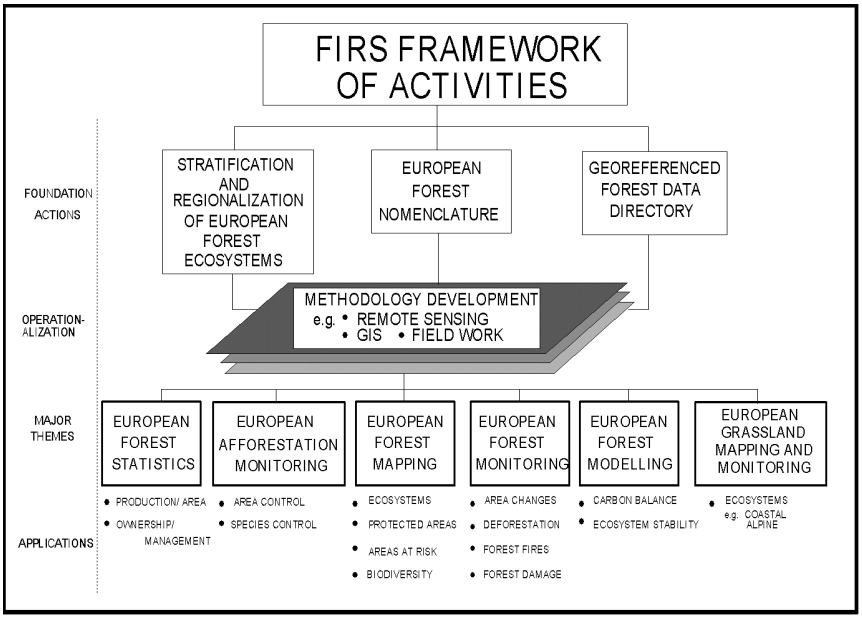

Figure 3. The structure of the FIRS project. Three foundation actions provide the input for the development of methods, which are used in the thematic applications.

Funding for the originally defined thematic application modules was not provided. However, other services of the Commission have launched projects which cover some of these modules or parts hereof:

1. DG VI launched a study on forest change monitoring (corresponding to a major part of FIRS Theme 4) and structural diversity mapping (corresponding to parts of FIRS Theme 3). The first part, forest monitoring has the objective to develop and demonstrate a system to detect and identify significant changes in forest cover. The major focus is on the detection of changes that differ from the normal vegetative succession of the ecosystems. The system will be as independent from ground data as possible. The key part of the study is to demonstrate the performance of the monitoring and change detection system in at least two different and representative forest regions of Europe.

   The monitoring and change detection system is based on optical satellite images. It includes both large scale and small scale monitoring. Other types of spaceborne remote sensing data such as ERS-SAR images will also be considered as additional data sources. The detection system is aimed at producing both change maps and statistics of the changes. The monitoring system that will be developed and proposed should also include an assessment of the accuracy of the information produced and address the cost-benefit compared to other methods, for instance ground based registration. The output of this study will be: 1) A description of the monitoring and change detection system; 2) A description of the accuracy of the system; 3) Sample maps of the results; 4) A description on how the change information can be utilised to update general statistical information of forests; and 5) An assessment of extrapolation possibilities.

   The main aim of the second part of the study, structural diversity, is to define, develop and test a system for monitoring the structural diversity of the forested areas. The diversity in forest structure is believed to be an important indicator of bio-diversity and may be assessed and monitored using remotely sensed data at at least two to three different levels (regional, community and population). This pilot study is carried out using the same regions as used in topic 1. The system will be based on high and medium resolution satellite data. It will be able to detect forest patches and to classify and describe both with regard to content and shape. The system will be linked to, and if possible integrated with, the change detection system developed under topic 1. The output of this topic will be: 1, A description of the system used to detect and describe forest structure (including the algorithms used for detection); 2, sample maps of the results; and 3, a description of the links and integration into a monitoring and change detection system.

2. The CEO project is financing two projects, which correspond partly to FIRS Theme 3 – forest mapping, and to FIRS Theme 1 – estimate of volume and above ground biomass. The objective of the FMERS study is to develop and implement methodologies for the provision of standardised georeferenced information and statistical information to describe the forests and other wooded land in Europe using optical and microwave space borne remotely sensed data. The target variables are forest and other wooded land as well as proportions of major tree species groupings. The mapping part of the study is divided into two phases: phase 1 in which the methodologies are developed and compared at six representative study sites across Europe; and phase 2 in which two large regions will be mapped according to results and requirements from the first phase. The main outputs of this phase are 1) quantitative evaluation of the potential of different satellite data types in discrimination of the target variables and 2) the proposal for a procedure to accomplish European forest mapping using medium resolution satellite data. (http://www.vtt.fi/aut/rs/proj/fmers/).

   The second part of the study, assessment of above ground biomass and volume, is just being launched, (spring 1998). It will provide research based experimental data sets from two test sites which will be included in the forest databases of the Space Applications Institute.
3. The EMAP (Environmental Mapping and Modelling) unit, to which the FIRS project belongs, has launched a project under FIRS Theme 4. This project will supply a forest probability map of the whole Pan-European area. The scale will allow an estimate of the probability of a single NOAA-AVHRR pixel (approximately one square kilometre) belonging to the class wooded land (forest and other wooded land). Thus the project will provide a Pan-European database consisting of both the probability values and the calibrated original satellite data.
4. The Decision Support and Integrated Assessment (DeSIA) Sector in the System Analysis and Modelling unit of the Institute for Systems, Informatics and Safety (ISIS) at the Joint Research Centre is is now using the existing FIRS data base for modelling (FIRS Theme 5). The DeSIA Sector uses the data to obtain a first estimate of the upper and lower bounds of the carbon dioxide sink strength of the European forests and is thus giving substantial support to the FIRS theme on forest modelling. (http://www.unitus.it/eflux/euro.html). The co-operation between DeSIA and FIRS does not only mean that DeSIA is responsible for part of the modelling theme of FIRS, it also means that FIRS will assist DeSIA in providing best possible data for future carbon modelling activities.

3 European Forest Institute's databases

The European Forest Institute (EFI) in particular is committed to compiling and disseminating forestry information at the European level. The institute has started to develop and implement an effective and well-organised information service for the European forest sector.

The EFI information service consists of both a forest information system presented as a user-friendly interactive database, and direct services through information specialists which compile information according to requests.

The forestry data are compiled, validated and stored in the main database using a '*Structured Query Language'*. Presentation tools are developed according to the type of input data. The general database structure is based on linking different data sets, which are part of the EFI databank. This concept is currently being implemented and will eventually allow the retrieval of all available information on a selected topic by specifying one query to the main database. All the data that are stored and "value added" by EFI, are processed and utilised in agreement with the data owners or original publishers. The rights of ownership are respected by clearly indicating the source of the data.

The UN-ECE/FAO Forest Resources Assessment of the Boreal and Temperate Zones, 1990 and the COST Action E4 project 'Forest Research Reserves Network' are mentioned here as examples held at the EFI databases.

1) The forest resources database allows the user to extract data on forest resources by selecting from the list of UN-ECE/FAO categories and countries using different web browsers. The query is sent to the database resulting in a summary table. Other features such as maps, graphical output (bar charts, pie charts) and a list of UN-ECE/FAO definitions can be selected. In its current form, full database services are available to EFI members, and the public has access to parts of them. *(*http://www.efi.fi/Database_Gateway/Forest_Resources*/)*. Similarly, work is ongoing to develop both, forest products and timber trade flow interactive databases.
2) The 'Forest Research Reserves Network' database has been developed as an interactive, user-friendly, on-line questionnaire, which stores the data directly in the database after submitting the data input. Access to the input of new data is restricted to the participants of the COST E4 action. With the help of an interactive search tool, the information can be extracted from the database according to individual user needs. The search function is open to the general public. The 'Forest Research Reserves Network' allows the retrieval of general information on forest reserves, suitable for research. The design and functionality of the network contributes to the exchange of research results and assists in finding nec-

essary research contacts in the field of forest reserves research (http://www.efi.fi/Database_Gateway/FRRN/).

4 Networked forest information

It should be taken for granted that to day all entities needing forest information are using digital equipment linked to some standard network. This should at least be the case for professional applications. The organisation of the databases, or rather the networking of the databases is very technology dependent, theoretically there should be no, or few limitations for cross-referencing of data, so it is in fact only the data availability that should be addressed.

To make the data available on networks does have severe implications for the data owners. They have to organise the data and decide on the availability, and they often have to redefine data responsibilities and perhaps even to take the possible uses of the data into consideration.

User requirements are slowly but continuously changing. We have few user requirement investigations and the ones we have are heavily biased towards the requirements from traditional forestry professionals, thus a large potential forest information user group is missing, namely the persons engaged in landscape planning and rural development who have no professional background in forestry.

4.1 User requirements

Two major European forest information user requirements studies have been made as mentioned earlier, one by the FIRS (Köhl and Päivinen, 1996) and one by DG VI – the EFICS study (DG VI, 1996). The latter study principally addressed the hard core forest community, international, governmental, regional and local forest authorities, and forest companies and forest organisations, but also a few NGO's were included. The FIRS study addressed three major groups, the production group, the environmental user group and a group engaged in the broader land cover planning aspects, however, all from the forestry community.

The EFICS study revealed that the two forest attributes "forest area" and "tree species composition" were the most important variables seen from a data user point of view. But, also that the "productive functions" of forest were of high importance. The fourth priority was "volume and annual increment and cut" followed by "biological richness and diversity". The sixth and seventh priorities were "volume and its change" and "health condition" respectively.

When asked to score very broad groups of forestry information types, the user replies were distributed as follows:

1) Wood resources: 83% of the users gave very high priority
2) Forest policy: 71 %
3) Research and development: 70 %
4) Forest industry production: 64 %.

This result indicated that not only wood and forest resources, but also

Table 1. The priority list of forest indicators and their need for harmonization. The three groups correspond to the user categories mentioned in the text.

Variable and variable-group	Harmonization needs
'PRODUCTION' VARIABLES	
Actual forest area	yes
Stand structure	yes
Diameter	no
Height	minor
Volume	yes
Drain / removals	yes
Timber quality	yes
'PROTECTION' VARIABLES	
Land cover	high
Health	no
Damage	high
Vegetation types	high
Water resources	high
Protection status	high
Naturalness	low
Threats to species diversity	
Environmental impact	
Wildlife habitats	
LAND USE PLANNING VARIABLES	
Land cover	high
Actual forested area	yes
Other wooded land	high

other information is of interest for most potential clients of EFICS.

The results of the FIRS study did not differ significantly from the EFICS study, however, the user group was divided according to "main responsibility" – see above. Table 1 shows the most needed attributes according to the user groups.

It is characteristic that the forest cover is the most wanted variable. It is probably also characteristic that the production oriented user groups puts higher priority on variables related to volume, drain etc. than the two other groups, which give higher priority to environmental indicators, such as protection and bio-diversity.

Both studies clearly revealed that the most important variables should be updated on a two to five year basis. The 10 year updating cycle which most countries now aim at does not seem to supply the information, often enough, to meet the user requirements.

Even if the users were not directly asked whether mapped information would be essential, both studies indicated a big interest in the availability of geo-referenced data. An earlier study clearly indicated that local

foresters needed regularly updated mapped information (Folving et al. 1992). The EFICS study user group was asked which variables after forest area they needed as mapped information. The reply showed the following priority: 1, protection and conservation; 2, species composition; 3, forest condition and damage. No doubt that the Criteria and Indicator (C/I) on sustainable development and, especially, on bio-diversity, would have much more weight to day and that a large user group should be included, i.e. managers dealing with risk assessments and hydrological planning and management – but working in entities not normally linked to the forest sector.

4.2 Implication for organisation

National forest inventories are supposed to build the basis for the EFICS initiative and the EUROSTAT databases are, according to the regulation, considered to be a key entity. It can thus be foreseen that the supply and updating of the statistical data reported for administrative units will be continued.

The European Environment Agency is obliged to provide information on the status of the Pan-European environment at regular intervals and has thus a need for forest maps, and maps of key forest indicators on, amongst other things, biodiversity. Already the CORINE Land Cover database includes important mapped forest information following the specific CORINE methodology.

EFI, as described above, WCMC and other important NGOs have compiled valuable forest information including maps serving various interests and needs. At a global level FAO is going to be a very important supplier of data on almost all forest aspects following the TBFRA2000 and FRA2000. This will be statistical information. EFERN (European Forest Ecosystem Research Network) is a very good example on a network, which is primarily dedicated to ecosystem research (http://efern.boku.ac.at). In the future EFERN will most probably serve a much larger user group that originally aimed at. IUFRO also provides valuable forestry information for Europe (http://iufro.boku.ac.at/)

Potentially all ingredients for the EFICS are existing. In reality, only the NGO's have had the necessary funding, and administrative and political freedom to get organised. The key issue for EFICS is not to have a large central database, but the availability of the data. It does in principle not matter where the data are stored as long as they are available. Available for whom? – is an important issue.

To become efficient EFICS should be supplied with the necessary possibility to co-ordinate the "data availability". And EFICS should have the possibility to assist the NFI to supply the data, which can be made public. As the application of EO data has been included in the EFICS regulation, co-ordination of the development and production of the new geo-referenced data and information types will be needed too. EFICS should also supply the necessary links to global data sets in order that European users easily can

access global forest information, and in order to make European data easily accessible for non European users, research and modelling networks.

4.3 Implication for the data

Both the EFICS and the FIRS studis very clearly revealed that the majority of the forest data cannot be directly compared at the European level. Most countries use their own set of definitions and methods. Therefore most variables or indicators need to be harmonised if correct comparisons are to be made (see Table 1). The EFICS study indicated four different alternatives for improving the situation:

1. To rely on existing national forest inventories;
2. To introduce a set of harmonised attributes in national forest inventories;
3. To carry out harmonised assessments at the national level in addition to the national assessments;
4. To conduct an independent EFICS survey at the European level.

The FIRS study, which was carried out before the four alternatives were set up, provided a proposal for a nomenclature to be used in forest resources assessments using EO data, which in fact fits very well with each of the last three alternatives.

At least for the variables and the indicators on bio-diversity, which easily can be assessed and monitored by the use of EO data, a new nomenclature and set of definitions should be implemented. Not least, because remote sensing can be foreseen to take over in the future as a cost effective data and information providing tool. For the variables and indicators on bio-diversity, which will still be relying totally on traditional field assessments also in the future, several possibilities exist for making the data comparable. The necessary conversion methods could easily be included in the FIRS toolbox mentioned previously.

For all data, regardless of the method with which they have been collected and provided, it should be clearly stated in the database how, when, by which method etc. the assessment was carried out. The high standards as used by for instance EUROSTAT and FAO today should always be the aim for any data provider. This may seem to be a rather redundant statement, but it should be clear for a user whether he finds raw data and observations or modelled and derived data. Hopefully, eventually, the reliability, or more precisely the accuracy and precision of the single data layers can be stated - both for the statistical and the mapped data.

In statistics there exists a long tradition for collecting and calculating data for administrative units and for arranging sampling to provide a single number for a single administrative unit. The EU forest statistics is given for various levels of NUTS. The National Forest Inventories are set up in the same way. Several key variables and indicators can today be provided as mapped information using EO data. The still growing demand for geo-referenced environmental data makes it much more ob-

vious to choose a natural geographical unit for reference. The catchment or watershed seems to be an obvious alternative. In fact, the catchment is the only useful reference area when we are dealing with the terrestrial surface and the direct influx to the sea and lake areas. This solution, which favours the EO data, so to speak, also forwards new requirements for the NFI data. These data have to be provided in a geo-referenced format for the sample plots, so that they can be used for "calibrating" and "training" in remote sensing applications. This might perhaps constitute a minor political problem, which could be solved by securing that the entities carrying out the national forest inventories also ware given the task and needed funding for providing the EO data derived mapped information.

5 Concluding remarks

When EFICS was defined 10 years ago, probably no one had foreseen, even imagined the growth in networked information in general. The very first estimates on the costs of running such a communication and information system came up with so high costs, that the momentum and interest from the Member States were lost.

The CORINE Land Cover map was used as an argument for not getting further involved in European forest mapping, and later the principle of sustainability made mapping at small scale a national item. It is of course correct that the CORINE map does supply much valuable information on the forested area and that the potential use is big; it is also correct that other forest variables are needed for many purposes. The Member States can easily supply all needed mapped information, however the comparative studies have shown that the users need harmonised information and that some organisation has to take the lead to secure common nomenclatures etc. The Standing Forestry Committee could secure this through EFICS.

During the 10 years, the need for an efficient forest information and communication system has grown tremendously. The many diverse initiatives mentioned above prove this. At the same time new possibilities in applying EO data have emerged. These data can be used for providing a part of the needed information more efficiently in a synoptical way with much shorter intervals than is normally possible though NFI's. They can also, to some extent assist in providing new insight in forest eco-variables. The demands for new types of forest information definitely prove that a need for an efficient communication system is existing.

The possibility for providing access to data with variable level of authorisation should make it easier to organise the data bases and should make it easier for data suppliers, as these would have to worry less about the sensitivity of the data and the derived information. Maybe it would also be considered beneficial if official data would be readily available, both in order to secure a high level of standard, but also in order to avoid

"invented" forest data and misinterpreted information.

There do indeed exist a need for a European Forest Information and Communication system, which can combine statistical and mapped data and derived information on the forests and other wooded lands in the Pan-European area.

References

Achard, F. & D'Souza, G. 1994. Collection and pre-processing of NOAA-AVHRR 1km resolution data for tropical forest resource assessment. TREES Series A: Tech. Doc. 2. EUR 16055, Office for Official Publications of the European Community, Luxembourg.

CEE. Council Regulation 1615/89. 1989. Official Journal of the European Communities, 15.6.89. No. L. 165/12-13.

DG VI. 1996. Unpublished report. Contract no. 9562c001.

Folving, S., Erntner, G. & Svendsen, T.B. eds. 1992. European Collaborative Programme Workshop on Remote Sensing for Forestry Applications. Copenhagen 13-15 Nov. 1991. EUR 144445.

Kennedy, P.J., Folving, S. & McCormick, N. 1994. An introduction to the FIRS Project. In: Proceedings to International Conference on Satellite Technology and GIS for Mediterranean Forest Mapping and Fire Management', Aristotle University, Thessaloniki, Greece, 4-6, November 1993.

— , Folving, S. & McCormick, N. 1995. Forest information from Remote sensing: 'FIRS' Project definition 1994-1999. In: Proceedings to Workshop on 'Remote Sensing in Landscape Ecological Mapping', University of Leuven, Leuven, Belgium, 17-19 March 1993.

Köhl, M. & Päivinen, R. 1996. Definition of a System of Nomenclature for Mapping European Forests and for Compiling a Pan-European Forest Information System. EUR 16416 EN, Office for Official Publications of the European Community, Luxembourg.

McCormick, N. 1998. An integrated system for mapping European forests using medium- and high-resolution satellite imagery: the SILVICSs oftware. Joint Research Centre, European Commission. EUR Report.(In preparation).

— & Folving, S. 1998. Monitoring European forest biodiversity at regional scales using satellite remote sensing. In: Assessment of Biodiversity for Improved Forest Planning. Bachmann,P., M. Kohl, R. Paivinen (editors). Kluwer Academic Publishers, Dordrecht, The Netherlands.