WORK REPORT

Institute for World Forestry

Reporting on Pan-European Criteria and Indicators for Sustainable Forest Management
– Experiences from Liechtenstein 2003 –

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Abstract

In order to monitor and report progress towards sustainable forest management (SFM), the third Ministerial Conference on the Protection of Forests in Europe (MCPFE) adopted a set of pan-European criteria and indicators in Lisbon in 1998. The criteria and indicators cover economical, ecological and social-cultural aspects of sustainable forest management at the national level. After a revision required by the same conference, an improved set of 35 quantitative pan-European indicators for SFM was adopted at the fourth MCPFE in Vienna in April 2003. The quantitative indicators require certain statistical information, specified by a number of classifications and attributes. This information has to be reported at the national level in order to enable a comprehensive picture of forests and their management within Europe. In 2002-2003, the Principality of Liechtenstein together with the Chair of Biometrics and Forestry Informatics of the Technical University of Dresden conducted a national case study aiming at a comparison between international data demands on one hand and national data availability on the other. In total, almost 200 data attributes were checked and analysed with respect to data availability and data potential. Results show large discrepancies between data demand and data availability. For some indicators the difference between the data required and data availability was enormous. Data were available for only 55% of the required attributes. Reported data and information were partly subject to certain restrictions and did not always completely fulfil the data requirements. The data availability (and also the reasons for no data being available) varied from indicator to indicator, and even from criterion to criterion. Based on the analysed data availability and the documented data report it was also possible to evaluate the available and reported data according to their data source as well as to their temporal and spatial resolution. In doing so, an extensive picture of the current data situation for Liechtenstein (data availability plus data consistency) is presented.

Keywords: MCPFE, criteria and indicators, sustainable forest management, data requirements, data availability, data potential, reporting

1. Introduction

1.1. Theoretical and Political Background

Sustainability is nowadays a concept utilized in the entire environmental context, but its origins lie in forestry. The term sustainability was first mentioned in a Saxonian forest law in the 16th century. In 1713 H.C. von Carlowitz (Speidel, 1984) described the principle of sustainability in the following words:

"...Therefore the highest skills, science, efforts and planning will be founded on how the conservation and growing of wood has to be organized in order to achieve a continuous, constant and sustainable utilization; this is an indispensable thing, without which the nation cannot exist."

Today sustainability is accepted as a general principle of forest management and was laid down in Agenda 21 of the United Nations Conference on Environment and Development (UNCED 1992). The UNCED called for the formulation of scientifically sound criteria and guidelines for the management and sustainable development of all types of forests (UNCED, 1992). In order to facilitate the implementation of the forest related UNCED decisions several regional processes were launched. In Europe the "Ministerial Conference on the Protection of Forests in Europe" (MCPFE) (launched in 1990) is the political initiative for cooperation of around 40 European countries and the European Union. Until today, four Ministerial Conferences on the Protection of Forests in Europe have taken place: 1990 in Strasbourg, 1993 in Helsinki, 1998 in Lisbon, and 2003 in Vienna, At the Second Ministerial Conference in 1993, a common definition of sustainable forest management (SFM) was agreed in Resolution H1 "General Guidelines for the Sustainable management of Forests in Europe" (MCPFE, 2000a).

Table 1: The six pan-European Criteria for SFM (MCPFE, 1998)

Pan-European Criteria for SFM:
Criterion 1: Maintenance and Appropriate Enhancement of Forest Resources and their Contribution to Global Carbon Cycles
Criterion 2: Maintenance of Forest Ecosystem Health and Vitality
Criterion 3: Maintenance and Encouragement of Productive Functions of Forests (Wood and Non-Wood)
Criterion 4: Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems
Criterion 5: Maintenance and Appropriate Enhancement of Protective Functions in Forest Management (notably Soil and Water)
Criterion 6: Maintenance of Other Socio-Economic Functions and Conditions

Based on the MCPFE Helsinki resolutions (1993) a follow-up process was initiated that developed pan-European criteria and indicators (C&I) as a common policy instrument for evaluating and reporting on progress towards SFM. At the third MCPFE (Lisbon, 1998) six criteria for SFM were formally adopted (see Table 1) and the associated indicators endorsed. In addition, the represented countries committed themselves to "proceed to implement, continuously review and further improve the associated indicators". At the fourth MCPFE held in Vienna in 2003 a revised set of 35 indicators was officially adopted (MCPFE, 2002a).

Within the six criteria of the updated criteria-and-indicator-catalogue there are 35 quantitative indicators and a set of qualitative indicators (Fig. 1). The qualitative indicators relate to the implementation policies, instruments and institutions at the national level. The fulfilment of the six criteria can be evaluated through the 35 quantitative indicators. The criteria characterise or define the essential elements or set of conditions or processes by which sustainable forest management may be assessed. By collecting and reporting statistical data regarding the specific information requirements of the quantitative indicators, these indicators show changes over time for each criterion and demonstrate the progress made towards its specified objectives (MCPFE, 2000b).

At the International Conference on the Contribution of Criteria and Indicators for SFM (CICI) in Guatemala in 2003, as well as at the Expert Consultation on Criteria and Indicators for SFM (ECCI) in the Philippines in 2004, participants identified seven thematic areas of sustainable forest management common to all nine regional and international criteria and indicator processes. At the fourth Session of the United Nations Forum on Forests (UNFF) held in Geneva 2004, the participants agreed on a resolution which acknowledges these seven thematic areas as a reference framework for sustainable forest management and invites countries to consider these elements in the development of national criteria and indicators (IISD, 2004). The agreed seven thematic areas cover the six pan-European criteria of the MCPFE (Rametsteiner, 2004).

In addition to National Forest Programmes (NFP), criteria and indicators are commonly seen as an important tool for monitoring, assessing and reporting progress towards sustainable forest management at the national and pan-European levels (MCPFE, 2003a), and play an important role in the implementation of long-term sustainable forest management. In order to

allow comparable pan-European forest monitoring, assessment and reporting, it is necessary to standardise and harmonise the definitions and nomenclature used in the criteria and indicators (Köhl et al., 2000).

To guarantee an optimal and functional working indicator catalogue at the pan-European level, the MCPFE focuses on three aspects in its work-program (MCPFE, 2000b):

- improving the existing indicator-set under consideration of the six pan-European criteria;

- exploration of further possibilities to harmonise forest relevant data and information assessments;

- elaborating a uniform and common reporting format for national data reporting.
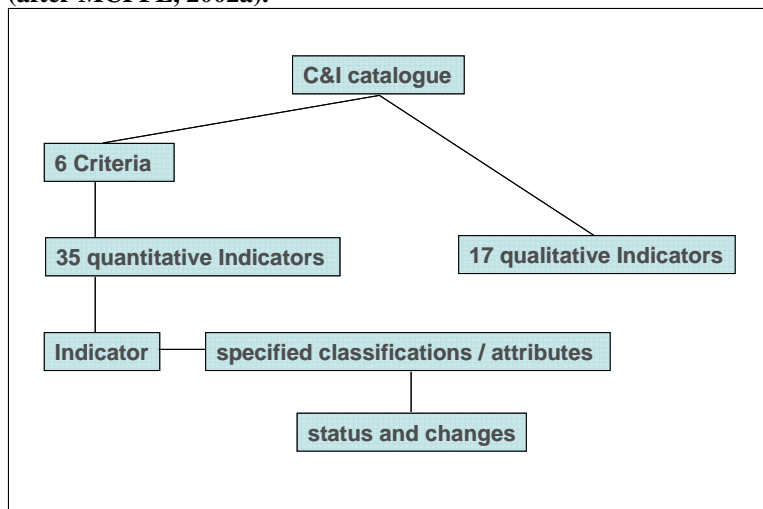
Data collection and reporting is carried out at the pan-European level, based on national-level data collection systems (MCPFE, 2000b; MCPFE, 2000c; MCPFE, 2003a). The indicators are to be reported not only as total figures on current state and changes, but further classifications are also requested (Fig. 1). These further classifications inevitably lead to an enormous complexity of the to be reported quantitative data.

The following example of the indicator 1.1 *"Forest Area"* provides an indication of this complexity. The MCPFE defines the reporting of "Forest Area" as:

"Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area"

It is not only *"Forest area"* which has to be reported as a single attribute. This one attribute is specified by further classifications. Even without taking into consideration other wooded land in this specific study, but taking into account that all other classifications have to be reported as *status* and *changes* data, at least eight different attributes are to be reported in the case of *"Forest area"*. Considering all requested classifications of all 35 indicators more than 200 single attributes are to be reported by each member country.

Fig. 1: The pan-European criteria and indicator catalogue - Complexity of information and data demand (after MCPFE, 2002a).

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          ┌──────────────┐                   \
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It seems as national forest assessments and inventories are a primary source of information on indicators. In addition to the "classic forest related sources and measurements", studies such as the Gap-Analysis of Sollander (2001) have shown that other sources are also essential for reporting, especially with regard to indicators that cover cultural or socio-economic aspects. In order to fulfil the reporting requirements of the MCPFE, an assessment will need to be made of whether data sources at both the national and sub-national levels are available and in how far those data sets are consistent. Such an analysis of data availability is fundamental for deriving an overview on reporting ability and quality.

International reporting structures are already in place. One important step in reporting criteria and indicators at the pan-European level was performed by the UNECE and FAO. The UNECE/FAO had already started to gather information about Europe's forests during the middle of the last century. The FAO, at the request of the member nations and the world community, regularly monitors the world forests through the Forest Resource Assessment Programme covering approximately 230 countries (see latest assessments FRA2000 in FAO, 2001; and FRA2005 in FAO, 2005). Within this global assessment, the coverage of the temperate and boreal forests (in the UNECE region) has been carried out under the auspices of the UNECE Timber Committee and the FAO Regional Forestry Commission for Europe. The latest explicitly regional assessment is the Temperate and Boreal Forest Resources Assessment (TBFRA 2000) (see UNECE/FAO 2000).

Based on these assessments the UNECE/FAO provided a first overall European-wide picture on the status of forest resources and management for the third MCPFE in 1998. This was repeated for the fourth MCPFE in April 2003 documented by the report "State of Europe´s Forests 2003" (MCPFE, 2003b). As this report was mainly based on the previous set of the MCPFE indicators (MCPFE, 1998) new indicators or changes in the indicator set could have not been considered.

For the next Ministerial Conference in Warsaw 2007 a new report[1] – structured according to the improved criteria and indicator catalogue – is under preparation. This report will be also prepared by the Liaison Unit of the MCPFE in strong cooperation with the UNECE/FAO. Advice and support is provided by the UNECE/FAO "Team of Specialists on Monitoring Forest Resources for Sustainable Forest Management in the UNECE Region" as well as by an ad hoc MCPFE Scientific Advisory Group. National data for that report will predominately rely on the FAO Forest Resource Assessment 2005 (FRA 2005). In addition, the MCPFE together with the UNECE Timber Committee has sent out a questionnaire to FRA national correspondents to ask for further required data not covered by the FRA 2005.

Most of the current National Forest Reports are not yet structured according to the pan-European criteria and indicators. Only a few examples like the Finnish or the Austrian Forest Reports presenting the data and information in the context of the six pan-European criteria (see: Ministry of Agriculture and Forestry, Helsinki 2001; Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Vienna 2002). In addition to a few selected and reported pan-European indicators they also list other indicators of national relevance.

To date, only the Principality of Liechtenstein has examined in detail the opportunities for fulfilling the specific information requirements of the pan-European criteria and indicators and presenting them in a simplified national data report (Requardt, 2003).

2. Case Study Liechtenstein – Methodology and Approaches

The Principality of Liechtenstein is an active member in the MCPFE-process and actively supports the implementation of all MCPFE resolutions into their national actions and

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[1] MCPFE Report "State of Forests and Sustainable Forest Management in Europe 2007/2008".

programmes – among others, the pan-European criteria and indicators (MCPFE, 2002b). In summer 2003 the "Chair of Biometrics and Forestry Informatics of the Technical University of Dresden" in cooperation with the "Office of Forest, Nature and Landscape of the Principality of Liechtenstein (AWNL[2])" conducted a case-study related to the question:

Which of the required data of the 35 quantitative indicators, both in quantity as well as in quality, can be supplied by the current information system of Liechtenstein, and how can available data be compiled in a simple but comprehensive data report?

To answer the question it was necessary to analyse the situation of data availability and data potentials, and also to prepare a criteria and indicator report based on available national data. In the case study a major emphasis was placed on reflecting the potential of national data for the reporting on improved quantitative indicators. The priority of the analysis of data potential was to reveal whether: (a) national data are available and can be reported, (b) available data (raw data) can be used but new data evaluations are necessary or (c) completely new methods of data collection and assessment have to be implemented to report required information.

Therefore the following specific objectives were of concern:

- to compile a comprehensive but clear data and information report structured according to the six criteria and 35 quantitative indicators

- to develop and apply a methodology to analyse and evaluate data availability and data potential

- to identify gaps, discrepancies and problems in the reporting, and also in the information system of Liechtenstein

- to analyse and evaluate format and consistency of available data as well as reliability of reported data

- to answer the question: Is the new improved criteria and indicator catalogue for the monitoring, assessment and reporting on sustainable forest management applicable in the case of Liechtenstein?

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[2] Amt für Wald, Natur und Landschaft des Fürstentums Liechtenstein

The applicability of criteria and indicators for the purpose of monitoring, assessment and reporting on sustainable forest management at the national level cannot only be described by the ability of national data sources for adequate data supply. *Validity, reliability* and *comparability* are further important aspects to describe in how far the indicator itself or the complete catalogue as well as the reported data and referred data sources are applicable for a long-term monitoring, assessment and reporting on sustainable forest management. An objective assessment of especially *validity* and *reliability* of all 35 indicators and all available data can be regarded as a complex and difficult task. To assess validity, several aspects as for example the indicator capacity for communication and problem identification but also its relation to other indicators the so called indicator connectivity or causality (see Mendoza and Prahbu, 2002; or Wolfslehner et al., 2003) have to be described in an objective way. However, the final question of applicability could only be partially answered as the conducted case-study focused mainly on the analysis and evaluation of data availability and data potential of national data sources to fulfil explicit reporting requirements of the pan-European criteria and indicators.

When analysing national data availability and data potentials for the reporting on the 35 quantitative pan-European indicators it was important to follow exactly described data demands as documented in the following MCPFE documents:

- Background Information for Improved Pan-European Indicators for Sustainable Forest Management (MCPFE, 2002c).

- Relevant Definitions used for the Improved Pan-European Indicators for Sustainable Forest Management (MCPFE, 2002d).

Each of the approximately 200 required attributes of all 35 indicators (including status and changes data) was classified according to its data potential. The basic elements of describing national data potential for reporting abilities are that either data – which could mean final explicit figures or also raw data – but also the methodology of data assessment or data processing are available or not. According to this assumption, the following basic cases were distinguished:

D – data available

d – data not available

M – methods available

m – methods not available

In order to provide more detail concerning data availability and data potential, the following specific classifications were applied in the Liechtenstein case study:

DM (A):   data and methods of assessment are available and available figures match data requirements – data can be reported in required form.

DM (B):   data and methods of assessment are available, but available figures only partially match data requirements – data can only be reported in another form, e.g. according to a different classification/definition from the required classification/ definition.

DM (C):   although data (raw data) and methods of assessment are available, explicit figures are not available.

Dm: raw data are available, but there is no knowledge on how to process raw data to derive required information (e.g. explicit functions or algorithms are not available).

dM: methods of assessment are known, but for various reasons no data has been assessed (e.g. because of limited resources/ capacities).

dm: neither raw data nor methods of assessment are known – no data potential.

Except for the case of *no data potential* (dm), all other classifications reflect a certain data potential. An explicit data report can only be produced for the cases DM (A) and DM (B). Other classifications have only a very limited data potential.

In the case that a data report was possible, each set of reported data was additionally accompanied by metadata[3] which describe data consistency and data format. The following additional metadata information was listed for each report:

- data source

- methodology of data assessment

- data error

- temporal resolution of data

- spatial resolution of data

When applying the above data potential classification including the metadata description, a comprehensive and clear structured analysis and evaluation of the national forest data situation could be accomplished. The data potential of various relevant national data sources could be described in relation to various data requirements both in terms of quantity and quality. Additional comments according to each data potential classification provided further background information necessary to understand the classification itself, but also to understand explicit data availability and data potential situation in more detail.

In this way it was possible to describe – for each of the approximately 200 required attributes but also in summary for the six pan-European criteria – whether national data sources of Liechtenstein are already able to provide required data or whether new methods of national data collection and assessment should be considered and implemented to fulfil explicit reporting requirements in the future.

3. Results
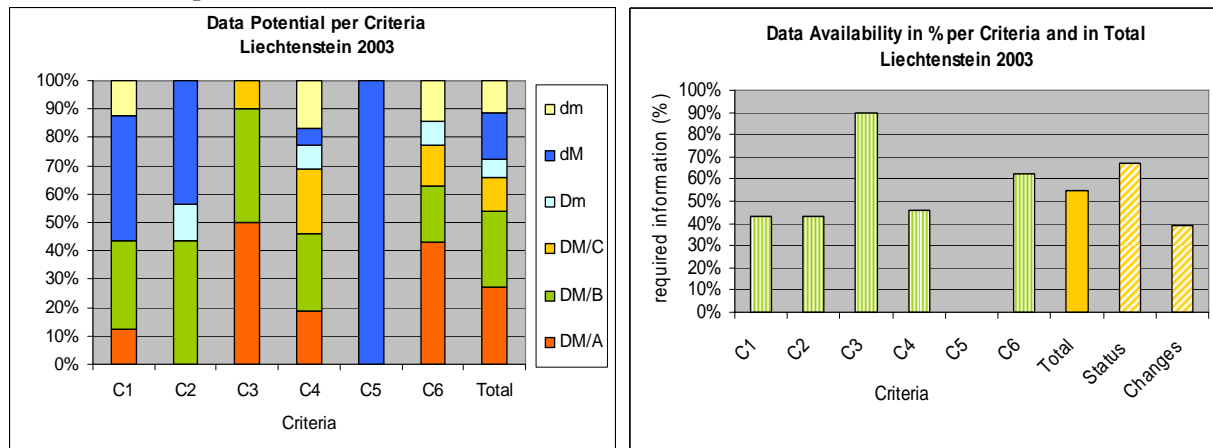
3.1 Data Availability

Within the scope of analysis, all 35 indicators were analysed and evaluated. In total 194 single indicator attributes were examined according to their data availability and data potential. Of

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[3] The simplest definition of Metadata is "structured data about data". Metadata is descriptive information about an object or resource whether it be physical or electronic (DCMI, 1995).

all 194 single evaluated attributes[4], 55% of the required information could be reported (see Fig. 2). This corresponds to an absolute figure of 105 reported attributes.

Fig. 2: Data availability and data potential of Liechtenstein 2002-2003, in percentage of required information (Requardt, 2003)

When examining the 55% of total data availability in more detail, it became obvious that only 18% fulfilled the specific data demands completely - mainly status data (see Table 2). All other reported data and information contain certain forms of restrictions or discrepancies either in content or format. Restrictions are expressed in manifold ways like interferences within the data or obvious limitations in data availability. For example, this means that for the indicators 3.2 "Roundwood", 3.3 "Non-wood goods" or 4.5 "Deadwood" only a certain amount of information could be reported, or that the information was incongruent.

As expressed in the structure and layout of the pan-European criteria and indicators (see Fig. 1), each single indicator attribute has to be reported according to *status* and *changes* data. *Status* data describe the current situation or state at the last data assessment. *Changes* data describe changes between at least two data assessments. According to the total data availability more status data could be reported as compared to changes data – 67% compared to 39% (see Fig. 2).

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[4] The indicators 2.2 "Soil condition" and 6.4 "Total expenditures for services from forestry" were only analysed within the data report. In cause of no definitive data requirements but also lack of data both indicators could not have been included in the final evaluation.

Table 2: Indicators with high data potential.

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35 of 105 available attributes completely fulfilled the explicit information requirements

Indicator 1.1 „Forest area" (Status)
Indicator 3.5 „Forests under management plans" (Status)
Indicator 4.3 „Naturalness" (Status)
Indicator 4.8 „Threatened Forest Species" (Status)
Indicator 4.9 „Protected Forests" (Status)
Indicator 6.1 „Forest Holdings" (Status)
Indicator 6.5 „Forest sector workforce"
Indicator 6.10 „Accessibility for Recreation

When summarising the outcome for each of the pan-European criteria, it became clear that the data availability and data potential varies from criterion to criterion. The data availability for the criteria C1, C2, C4 and C5 was below 50%. Only for the criteria C3 and C6 more than 50% of the required information could have been reported. The 90% data availability for the criterion C3 "Maintenance and Encouragement of Productive Functions of Forests (Wood and Non-Wood)" is extraordinary high compared to the situation of other criteria. Also noteworthy was that no data could be reported for the two indicators under criterion C5. The situation of criterion C5 reflects a very specific data situation for the year 2003. In 2002-2004 Liechtenstein completely renewed its applied methodologies for the assessment and monitoring of protective forest functions (e.g. by introducing remote sensing techniques and GIS based mapping systems). Therefore, all previous available information (old data) could not be taken into account as there was no distinct relevance or correlation to other existing up-to-date information sources of Liechtenstein's forests.

The reasons for no data availability and varying data potentials became especially clear by evaluating the situation for each of the 35 indicators. One of the most common causes for no data availability was that the methodology of data assessment and data processing were known, but no raw data for further data-processing and calculation were assessed. This was the case especially for additional indicator classifications – classifications which specify indicators according to additional attributes – for example, classified by forest type or classified by availability of wood supply.

Also relevant was the cause of no data potential (see classification dm). Some indicators (e.g. indicator 1.4 "Carbon stock" and indicator 6.7 "Wood consumption") were classified as dm, i.e. neither a methodology of data assessment/data processing nor any basis-data (raw data)

for further data processing and calculation were available. In some cases (e.g. indicator 6.2 "Contribution of forest sector to GDP"), even when raw data and methodologies were available, the required figures had not been assessed and evaluated. Major reasons for this type of limited data potential were that there were limitations in personnel resources, or there was low motivation for assessing such information.

By reviewing the described limitations and obstacles in reporting it becomes obvious that the current data availability and data potential could be improved considerably by taking more advantage of the theoretical data availability and potential. For certain information some of the relevant data (raw data) do actually exist. Some data are actually assessed but not used or evaluated any further. A repeated evaluation of potentially available data which takes more account of the requirements of the pan-European criteria and indicators would result in a much higher rate of data availability as was the case in the year 2002-2003 when this case study was conducted.

This becomes clear by the following example:

Within the National Forest Inventory (NFI)[5] of Liechtenstein a classification of forest according to forest type is actually assessed, but most of the NFI parameters (e.g. timber volume or increment) are finally evaluated according to other classifications. This is explained by the different information interests the authorities and forest stakeholders of Liechtenstein have in their forests. As Liechtenstein's landscape is characterised predominantly by mountain or alpine ecosystem conditions it is of more interest to evaluate certain forest parameters according to different altitude belts rather than to forest types.

3.2 Data Consistency

Data consistency can be illustrated by several parameters. This study focused on the evaluation of available data sources as well as on the temporal and spatial resolution of reported data (see Fig. 3).

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[5] The NFI of Liechtenstein is orientated according to the NFI of Switzerland. The Swiss Federal Research Institute of Forest, Snow and Landscape (WSL) is partly responsible for the NFI of Liechtenstein. The Office of Forest, Nature and Landscape of Liechtenstein (AWNL) decides which of the data and attributes have to be collected and finally evaluated. Final data processing and data evaluation are done by third parties.

Fig. 3: Data situation according to data source as well as according to temporal and spatial resolution of available and reported data (Requardt, 2003).
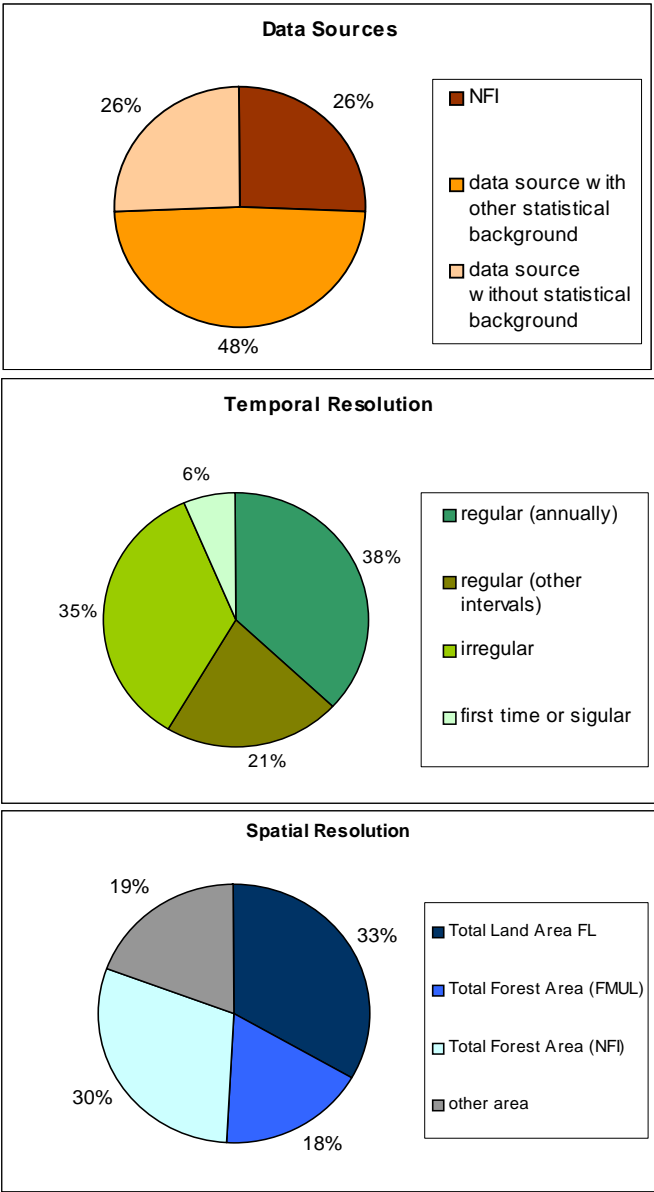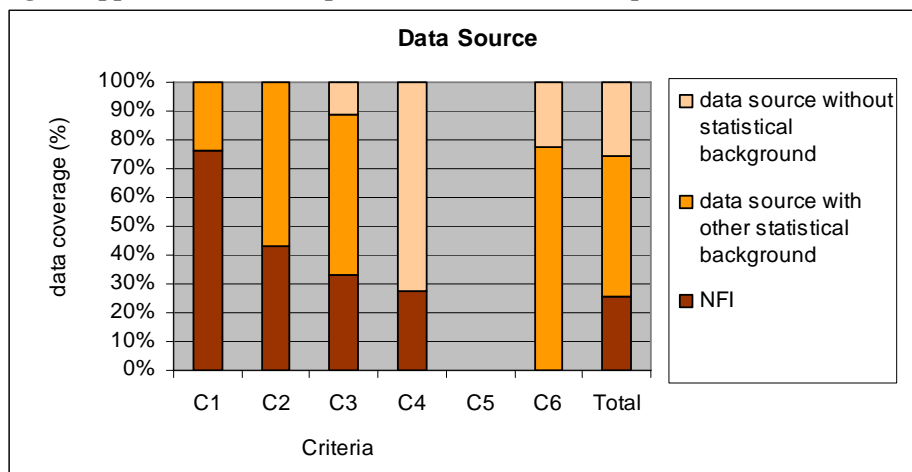

Data Sources

Almost 74% of the 105 reported attributes relied on statistical sources. The remaining 26% refer to data sources without any statistical background – predominantly regarded as data coming from expert guesses.

The NFI covered slightly more than 26% of the reported data. Compared to the in total 194 examined attributes this corresponds actually to NFI data coverage of only 14%. Of all 35 indicators eight indicators rely completely or in part on data of the NFI.

The Liechtenstein case study shows that the NFI is able to supply only some of the required data. By examination of each of the six criteria it became obvious that the role of the NFI for adequate data supply varies between the criteria (see Fig. 4). For example almost 80% of required data of the criterion C1 rely on NFI data. For the criteria C4 and C6 it is only about 25%. The case study shows the NFI provides data predominately for classical forest parameters as forest area, growing stock, age structure and diameter distribution or increment and fellings. It shows also that most of the relatively new forest parameters as for example of the indicators 4.7 "Landscape pattern", 6.6 "Occupational safety and health" or 6.10 "Accessibility for recreation" rely on other sources – sources which are not necessarily traditional sources of information about forests.

Fig. 4: Applied data sources per criterion and total (Requardt, 2003).

As it was also described by the Gap-Analysis of Sollander (2001) the Liechtenstein case study shows that other national sources are relevant for the provision of quantitative data to describe sustainable forest management using quantitative indicators. Actually it shows that in the case of Liechtenstein the bigger part (48%) of available data refer to data sources with other statistical backgrounds. These data are either simple collected tabular data, like wildlife and hunting statistics or forestry employment statistics, or more complex statistics like data assessments for the national timber market. Most of available statistical data, however, can be characterised as simple descriptive statistics.

Although almost 74% of all reported data relied on statistical sources, explicit information regarding data error (e.g. absolute or relative standard-error) was only available for NFI data. The lack of statistically described error budgets (e.g. the description of quantitative measures

as sampling error, sampling unit, etc.) of reported data made it difficult to provide a final assessment and evaluation of data reliability.

Temporal resolution

The temporal resolution of all available reported data shows that almost 60% of the data are collected and assessed at regular intervals, where about 40% relied on annual and 20% on other periodical intervals of data collection (Fig. 3). As the amount of irregularly collected data was about 35%, and only some of the reported data rely on first- or singular data collections, it can be concluded that almost all reported data (94%) were collected and assessed at periodic intervals (either regular or irregular). Considering these circumstances, it is surprising that only 39% of the changes data could have been reported. There are a number of reasons for this.

Some of the NFI data were for example assessed in both last inventories, but an explicit evaluation of temporal changes was not made (e.g. for attributes of indicator 2.4 "Forest damage"). In the case of modifications and changes in applied measurements and definitions – respectively changes in interest or technical improvements – no distinctive evaluation of changes was possible. Some data (e.g. for indicators 4.5 "Deadwood" and 2.4 "Forest damage") had been assessed for the first time, although they might be assessed regularly in the future. Hence an evaluation of changes had not been possible so far.

Spatial resolution

The highest proportion of reported data (approximately 33%) represent the whole of the total land area of the Principality of Liechtenstein (16 040 ha). Data with that kind of spatial resolution occur mainly in the reports of criteria C4 (50%) and C6 (55%). About 30% of reported data represent the forest area according to the NFI. These are the NFI data itself plus the data of forest condition monitoring as both rely on the same sampling grid.

Almost 19% of all data are reported at spatial resolutions which are unique for certain types of data (e.g. for attributes of the indicators 3.3 "Non-wood goods", 3.4 "Services" or 6.1 "Forest holdings"). For example, within the indicators 3.3 "Non-wood goods" and 3.4 "Services", the hunting and wildlife statistic refers to a reference area that is different to the forest area but also different to the total land area of Liechtenstein.

About 18% of data are reported for the forest area according to the database of the Forest Management Unit Level (FMUL). Examples are data of the indicators 4.3 "Naturalness" and 4.6 "Genetic resources". The FMUL data base is a data base which provides basic forest information based on stand level assessments. Classical forest data as *growing stock* or *increment and fellings* rely in the report on the assessments of NFI and not on the FMUL data base. This guarantees a continuity and comparability of most data within the report.

The evaluation of spatial resolution of reported data has shown that some attributes are assessed according to other spatial resolutions than specifically forest area. It shows that required attributes of the pan-European criteria and indicator catalogue reflect not only forest itself, but also other ecological, economical and socio-cultural components within a country. Certain data are not necessarily assessed only within forests, and a later evaluation of available data according to different landscape elements or habitats is difficult or impossible. This was, for example, the case for most of the reported data of indicator 4.8 "Threatened forest species" As it is sometimes difficult to classify species as forest living species.

3.3 Gaps, Discrepancies and Other Problems

Additionally to the described primary results as data availability and data consistency several interesting secondary results were identified. Secondary results describe gaps, discrepancies or problems within the information system of Liechtenstein but also obstacles and constraints as they were experienced in the applicability of the criteria and indicator catalogue. Examined and documented at the example of Liechtenstein, the analysis of data availability and data potential as well as the data report revealed problems which complicated the reporting on pan-European criteria and indicators. Data gaps and data inconsistency within the report make compiling a clearly structured report a challenging task.

Despite the relatively low rate of 55% of total data availability, an enormous amount of data and information could have been reported. In some cases the reporting was very complex and diverse. Even if data did not completely fulfil the data requirements, it was possible to report at least some data. That means that in some cases data with limitations and restrictions either

in content or format were used (e.g. data were reported according to other classifications than those specified in the indicator catalogue).

The data report became more complicated in the case where it needed to rely on different data sources – data sources with different definitions and methodologies of data assessment. Some reported data did not fit to or did to match with other correlated data. This was for example the case in the data report of the two closely related indicators 3.1 "Increment and fellings" and 3.2 "Roundwood". This kind of non-congruent information made the final data report in its whole report statement partly fuzzy or clouded.

One of the most challenging problems in reporting – especially concerning the aspect of data comparability - was the problem of reporting *total forest area*. As shown in Table 3, Liechtenstein reports three different *forest area figures* which rely on three different but relevant national data sources. As there is no definitive answer as to which of the three data sources provides the most reliable estimate of forest area, all three figures were reported in indicator 1.1 "Forest Area".

Table 3: Total forest area of Liechtenstein, according to the three most relevant national data sources (Requardt, 2003).

Data Source	Total forest area (ha)	
National Forest Inventory II (LFI 1998)	6091	
FMUL data base (AWNL-forest management unit)	6866	
Federal Office of Statistics of Switzerland - Arealstatistik 1996	6748	

The problem of total forest area leads inevitably to a chain of further problems. Many attributes and indicators are correlated to the indicator 1.1 "Forest Area". As a result, many other variables – such as total volume of timber or increments and fellings – may easily be misinterpreted or misunderstood. The ambiguity regarding total forest area and the risk of misinterpreted data also leads to difficulties in implementing forest planning actions and programmes. However, it can be safely assumed that the problem of forest area is not only a

problem in Liechtenstein, but will also apply to other countries who may maintain different forest data assessments for certain purposes.

4. Discussion

At the International Conference on the Contribution of Criteria and Indicators for SFM (CICI 2003) it was hypothesised that only a limited number of new data needs to be generated or collected for adequate criteria and indicator reporting (FAO, 2003). The case study of Liechtenstein partly supports this hypothesis. The situation of limited data availability in the year 2003 could be strongly improved by an optimised utilisation of the theoretically available data potential. Data which are collected anyway but are not evaluated and used any further could theoretically be newly interpreted and evaluated according to international data demands, as for example expressed by the pan-European criteria and indicators. The AWNL of Liechtenstein (or in general national authorities in any country) must define whether and to what extent new data collection and data evaluation are necessary to meet national and international reporting requirements and at what cost the most benefits to fulfil both demands can be obtained.

It is concluded that not only improvements in national information systems are needed, but that further research will need to be conducted for certain indicators required by the new catalogue. This is for example the case for the indicators 6.4 "Total expenditures for services" and 6.11 "Cultural and spiritual values". Ambiguities concerning what exactly has to be reported complicate the reporting on these indicators. There is a lack of knowledge about how this specific information could be assessed, and also there is no clear indication about what information is required. Further surveys which analyse and define the requested range of values and data, as well as surveys which develop, improve and implement applicable ways of data assessment should be conducted in the future. This can be regarded not only as important for the two indicators 6.4 and 6.11, but also for the whole catalogue in general.

Taking into account the results of the case study of Liechtenstein, the following questions arise:

- Can the required information of the pan-European Criteria and Indicators be supplied and reported by the other countries of the pan-European MCPFE process either in short- or long-term?

- If in a small country like Liechtenstein (where data assessment and data administration are closely linked and coordinated) only about 55% of the required data could have been supplied for the 35 pan-European indicators, how can this specific information be supplied by much larger and more complex or federal organised countries, as for example Germany?

The situations regarding data availability in each country will be different, and no general and simple assessment of the respective data situation/ availability in other countries can be applied.

The abundance or lack of data may also be linked to the diverging needs of data by different user groups. In the Principality of Liechtenstein this is quite obvious as for certain types of information the number of interested parties are relatively small. Due to limited capacities in personnel resources (e.g. for conducting long-term assessments and monitoring tasks) attributes such as the indicators 1.4 "Carbon stock", 2.1 "Deposition of air pollutants", 2.2 "Soil conditions", 4.6 "Genetic resources", 6.2 "Contribution of forest sector to GDP" or 6.7 "Wood consumption" are not assessed and therefore could not have been reported.

On the other hand it was possible to assess and collect certain types of data for specific indicators during the relatively short time of the survey. Due to the simple and compact structure in organisation, administration and institutional cooperation – which can be expressed also as relatively short and direct informal information strands – it was possible to compile and report data for the indicators 3.3 "Non-wood goods", 3.4 "Services", 4.8 "Threatened forest species" or 6.11 "Accessibility for recreation" by using relevant and existing data collection initiatives.

5. Conclusion

One of the major purposes of the pan-European criteria and indicators is to assess and monitor forest management on the national or regional level by applying a common nomenclature in

order to allow common conclusions and actions concerning the national and regional forest management and its sustainability over time.

As the criteria and indicators cover a wide range of information, they can be considered as a suitable instrument to analyse and evaluate the forest data situation and information management at a national level and also at a European level.

Even if some of the required data cannot be supplied at present by MCPFE member countries, it should be of high interest to promote and conduct further national case studies. It has been demonstrated in this study how the operability and applicability of the pan-European criteria and indicators and their meaning as a reporting tool in the case of Liechtenstein could be assessed. It has been shown that the pan-European criteria and indicators are applicable for the monitoring, assessment and reporting on SFM on national level, but that the deficits between demand and supply of relevant information are substantial, and that the reasons for this are various.

One of the relevant causes for no data availability in the case of Liechtenstein in the year 2003 was that neither a methodology of data assessment/ data processing nor any raw data for further data processing and calculations were available. In this case the Liechtenstein authorities have to consider whether new methods of data collection and assessment are necessary, and whether it is in their interest to improve data availability and national forest information situation.

However, the study has shown that actually a certain data potential does exist for most of the required data – either in form of available raw data or that methods of data collection or data processing are known. In cases like these it can be concluded that it would be often just a matter of slightly modifying existing data sets or data evaluations in order to explicitly fulfil international information requirements.

The Liechtenstein case study shows that many different national sources are relevant to provide quantitative data. It shows that the NFI of Liechtenstein is able to supply only few of the required data. Therefore it can be concluded that the NFI is not such a key source for criteria and indicator reporting as one may assume.

Nevertheless NFIs as a wide ranging national forest assessment are a substantial and important data source of national forest data. Therefore it is crucial to conduct further similar national case studies where the relation between international forest data demands – for example expressed by the pan-European criteria and indicators – and the data potential of NFI for adequate data supply is analysed. Such analysis can be regarded as a fundamental approach towards the process of international harmonisation, as it is for example in the focus of the EFICS regulation of the European Commission or the current activities of the ENFIN Cost E43 action .

The results do not allow for generalisations to be made about the situation in other countries, but it can be assumed that similar tendencies and obstacles as in Liechtenstein can be found with respect to the relation between international information demands and national data supply.

Lack of reliable data as well as limited resources (personnel and financial) are often major obstacles. The challenge lies in the improvement of the technical and financial capacity to manage and process the data from various sources for various purposes. Using synergies between different national data sources and also between national and international data collection initiatives but also building harmonised bridges between various reporting obligations are fundamental to making sure that efforts in reporting and data assessment are not duplicated. The harmonisation of data supply and data demands is the key to make certain core information (e.g. for the assessment of sustainable forest management within Europe) available on a comparable basis.

National case studies as conducted for the example of Liechtenstein can be seen as an effective approach to analyse and evaluate comprehensively national and European data situation, but also to promote the understanding and meaning of harmonised monitoring, assessment and reporting on sustainable forest management.

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