Inventory, Modelling and Auditing Systems for Planning and Controlling Forestry Operations

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ABSTRACT

This paper attempts to review briefly in broad terms the need for researchers and managers of forestry operations to collate their respective knowledge and experience in order to assist the process of designing appropriate inventory, modelling and auditing systems for planning, controlling and reporting operational performance responsibly and effectively. The approach taken here is to outline a relevant philosophy, supported by a few examples regarded as typical of what is envisaged. The aim is not to focus on one particular situation, but to emphasise crucial aspects in general of: (i) multi-resource, pre-harvest inventory (ii) integrated market-led strategic, tacticaland operational modelling, and (iii) developing and implementing routine procedures to monitor, control and audit outcomes, so as to provide ecosystem accountability. Knowledge on how to proceed in principle is widely available, but there is still apparent resistance to adopting worthwhile technological improvements routinely. Some suggestions are given on how forest management pertaining to the above three aspects could be beneficially redirected.

Keywords: *forest management inventory, modelling, planning, monitoring, controlling, auditing.*

INTRODUCTION

This article reflects a personal view on the need to coordinate procedures employed in planning and managing forest resources for a range of purposes. For many years, responsible forest resource managers have held to the concept of sustained yield of timber harvest in both quantity and quality, and have assumed that, if sustained yield was achieved, the whole forest ecosystem would be in good heart in all respects. But sustained yield was not always practised and even when it was, it was rarely documentedin formal reports available to the public. Consequently, concerned people, including forest managers themselves, have been unable to refer to and evaluate verifiable evidence about the ongoing state of ecosystems. A well known consequence is that the general public has mostly taken the view that unacceptable adverse impacts on ecosystems and the associated environments occur all the time in managed forests, an attitude which is often reinforced by various media commentators. In short, loggers and foresters have had a bad press in many park of the world. To some extent, such views have not been adequately countered by either the forestry profession or the timber industry mainly because of a lack of clear objective evidence about the ongoing state of forests and whether or not they are being managed sustainably.

Principles arising out of the 1992 UNCED summit in Rio and subsequent initiatives and developments world-wide have helped to restore a more balanced perspective on the true nature of forests which has to an extent been taken on board by some people in some countries. It is important therefore, that forest resource managers take the opportunity offered in various international protocols (e.g. the Montreal and Helsinki Processes) to document in acceptable standard ways what impacts their operations are actually having on specific forest ecosystems. There is a particular need for harvesting personnel to be fully aware of responsibilities applicable over a broader perspective than hitherto because they are the ones receiving the most adverse publicity.

This paper deals with ways of demonstrating sustainability which is at the heart of the matter, without the need for outside certification, and in objective ways which could be used to counter emotively inspired opinions. Sustainability is currently a fashionable term, but a word which appeared in many English language dictionaries only in ik adjectival form (sustainable) until the 1980's. There is still confusion about what it really means and so the next section explores the meaning of the term and sets out what it is taken to mean here.

MEANING OF SUSTAINABILITY

Sustainability is a term which is now generally understood to refer to flora, faulia and physical attributes within ecosystems, in terms of their associated biodiversity, soil and water qualities, scenic, recreational and amenity values, usufruct rights and other such system elements in addition to harvest yields. There is general acceptance of this

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perspective, but sustainability still appears to mean different things to different people. There was agreement at the Rio Summit that the ecologists' view that management and use of a forest should not destroy the potential of a forest ecosystem to offer the same or even enhanced quantity and quality of goods and services in perpetuity, but that economic and social considerations should also be included. Conservation of resources and their so-called intrinsic values cannot be conducted in a vacuum when there are competing pressures on their legitimate uses. Management should be directed to elicit trade-offs so as to assist resolution of the inevitable conflict arising from competing uses for resources, but this approach can be successful only if all interested parties are willing to compromise. Fuller discussion of this issue is contained in two earlier publications, Whyte [11] [12]. Suffice it to say here that sustainability could be assumed to mean, from a utilitarian point of view:

> *"maintaining the supply of as many benefits, goods* and *services at as high a joint level* of each as can be *reasonably supplied in perpetuity, without permanent loss ofcurrent resourcemanagement options".*

It also needs to be noted that the quality of the resource depends, on the one hand, on leaving a forest more or less intact, while on the other, recognising that some elements of the forest, (e.g. wood, fruits, bark, resins and medicinal plank) involve consumptionon- or off-site. This is the kind of conflict that has to be resolved managerally and there needs to be a greater effort by researchers directed to that end, and less towards their own perception of what is needed purely from a technological viewpoint of interest.

RESOURCE MANAGERS RESPONSIBILITIES

In responding to the above challenge, forest resource managers need to be committed to collecting processing, storing, analysing, retrieving, summarising and tabulating in various aggregations huge quantities of data pertaining to characteristics both within and without the forest. All this information has to be available to mangers from at best a regularly updated, comprehensive relational data-base management information system, which can he employed as a means of readily reporting the state of a forest ecosystem and of predicting the ecological, economic, social and cultural consequences of implementing various management activities. If any decisions taken, together with the actual outcomes of implementing these decisions, could be made transparent to all stakeholders, including environmental lobbyists, many of the arguments could well dissolve. But how is this transparency to be achieved?

There is a major problem in this regard as indicated in a paper at the 1991 IUFRO World Congress by Whyte [10]. The two main questions posed were *"are forest managers* using *researchers' tools to best* use *in routine management"* and *"are researchers providing the right kinds* of *tools to serve managers' actual needs"?* It was argued in that contribution that the answers to both these basic questions was "no". The following sections try to illustrate how aspects of planning, modelling and auditing timber harvest operations could be better conducted.

PRE-HARVEST INVENTORY AND PLANNING

The need to plan and conduct harvesting operations, which accommodate and even enhance the multi-function character of all types of forest, needs to be not only addressed but successfully implemented. F or example, Chapter 11 of Agenda 21 of the Rio Declaration identifies four priority areas:

(1) sustaining the multiple roles and functions of all types of forests and woodlands;

(2) enhancing the protection, sustainable management and conservation of all forests and the rehabilitation of degraded areas;

(3) promoting efficient utilisation and assessment to recover the full value of goods and services provided by forests and woodlands;

(4) establishing or strengthening capacities for assessing and systematically reporting data on forests and forestry activities (including commercial production and trade).

There is little clear available evidence to date that these international priorities are now being successfully adopted in practice. The need for a balanced framework when recommending specific forest harvesting practices and for providing reports on them, impacts and costs, is recognised in the FAO Model Code of Forest Harvesting Practice [2]. The Code recommends:

(i) recognition and inclusion of all relevant resource, environmental and administrative costs (both incurred and opportunity ones), when making

production and consumption decisions;

(ii) adopting environmentally sound harvesting techniques which are also economically practical and technically efficient;

(iii) modifying contracts so as to ensure the return of a greater share of profits to society;

(iv) incorporating the needs and desires of local and indigenous peoples and their right to participate as stakeholders in decisions pertaining to forest resources.

If these principles are to be adopted, there is, as previously mentioned for forestry in general, a huge managerial commitment to collecting, storing, analysing, retrieving and aggregating the data needed to plan, conduct and evaluate harvests accordingly. Multi-resource items both inside and oukide the forest might include consideration of:

- land on which the forest occurs
- [illegible]
- resident animal populations
  - yielding capacity of wood, other tree and plant products, water run-off, sediment load and the like
- crop production actually realised
  - protection, recreational and amenity values actually realised
- costs and revenues of sustaining a flow of goods and services
  - demand forecasts for forest outputs
- labour and equipment capabilities and productivities
  - social, cultural, stakeholder and environmental responsibilities.

How refined and accurate any of these measures and indications need to be depends largely on how all these hinds of information are to be utilised and reported. There has often been a tendency to adopt a method of inventory that is used over and over again no matter what the purpose. Researchers have often recommended forms of inventory and mensurational techniques to suit a specified set of managerial requirements without knowing whether the same outputs are needed in other situations. Managers often assume that circumstances and methodologies are set in concrete, when the reality is that only general principles should apply to any one situation. Measurements variables and techniques, however, should match individual informational needs, resources, budgets, data- processing capabilities, forms of analysis to be employed and tabulations to be reported. Recent work in New Zealand (as yet unpublished except in organisational report form), for example, has shown that harvest methods designed to lessen environmental impacts, such as aerial or cable extraction, may bear similar overall costs to clearfelling by skidder when all relevant, and not just extraction, costs are taken into proper account [1].

What is also not always done routinely is to start at the end, namely specifying the kinds of tabulations needed to characterise the present and likely future ainditionsoftheforest ecosystem in report form. Then, consideration of what information is already known and verified, together with the appropriateness of various measuring, sampling data- processing and modelling options applicable to individual circumstances should provide the basis for recommending how to proceed. In other words, there needs to be an overall decision-support system, broken down into sub-systems, which are fully integrated and coordinated park of the whole system. An example of this approach applied to a plantation system on communally-owned land is presented by Whyte [8] [9]. Harvest planners should ensure that their data-gathering and processing are compatible in such ways. It is a personal observation that this compatiblity exists only rarely in practice. Managers, therefore, need to recognise and specify exactly what outputs are needed, while inventory practitioners need to use research results and the researchers' specialist knowledge to adapt the processes to meet specific managerial objectives.

Managers and researchers may not be able to interact very often on a one to one basis, but today there are templates and knowledge based systems in which managerial users of researchers' knowledge can be clearly explained step by step on how to proceed, in ways suited to individual circumstances [6] [4]. There is a need however to provide many more modular sub-systems with such knowledge-based supports, to meet the multi-functional nature of resource management today.

IUFRO guidelines for designing multi-resource inventory systems have been drafted by Lund [3]. Detailed inventory considerations for the management of forests, range, recreation, water, soil, air, wildlife, fish, minerals and land in general are provided in this draft, but one is left wondering to what extent the guidelines are being implemented in current practice. The proposals advocated here are philosophically consistent with these IUFRO

guidelines, particularly with respect to setting objectives at the outset, coordinating component park and providing reported outputs to meet international requirements for forestry statistics, developing national and regional strategic plans, and implementing tactical/operational local plans. An important aspect outlined by Lund deals with taking advantage of modem technologies such as GIS, geo-referenced data-bases and electronic measurement and data-recording. Management inventory practitioners need to be aware of what is being offered in this regard and to take advantage of the improved cost-effectiveness some new techniques can provide.

MANAGEMENT MODELLING

Appropriate models for a range of purposes should be integrated in the same way as inventories. This should also be organized hierarchically and individually, tailored to suit specific circumstances, as explained in Whyte [8] [10]. What often happens is that the same models and their outputs are used over and over again to cover a wide range of general purposes, just as is the case with choice of inventory, instead of tailoring, which out of several optional forms, best addresses specific characteristics. What is of even more concern is the managerial pre-occupation with wood supply considerations to the apparent neglect of other issues such as global warming and the greenhouse effect, countering resource- preservation propaganda about adverse environmental impacts, transparency of the modelling inputs and framework, and interactive decision-making which could involve all stakeholders. The full range of markets for outputs of goods and services has to be recognised and models built to meet all relevant market demands.

Surveys of published literature reveal that much work has been done in modelling individual aspects of harvest planning but not necessarily in a desirably, integrated way, especially with regard to evaluating optimal trade-offs across different planning horizons and among strategic, tactical and operational planning levels. An example of such hierarchical integrated forest harvest planning is given in Ogweno [5], including multiple-objective modelling of wood production. This methodology does, however, need to be applied jointly along with the inclusion of objectives pertaining to non-timber aspects. There are countless examples illustrating the success of this in fields such as soil and water management, but very few relating to timber production in today's context. Notional exercises to indicate the relative ease of use of multi-criteria decision- making models have been outlined in, for example, Whyte [11] [12], but there is little evidence of their routine adoption in forest management despite their application in soil and water management for more than thirty years.

MONITORING, CONTROLLING AND AUDITING

These three managerial functions, just as for the previous two, should be addressed and conducted within organisations and designed to suit individual circumstances. 1 t is my personal opinion that it is far better for organisations to do this themselves rather than have outside international certifiers being both the appraiser and arbiter. By all means, have outside certifiers appraise an organisation's performance in this regard with, for example, random checks, but there is too long a history of organisations concentrating on meeting standards imposed externally and not enough on satisfying overall resource management standards, as the two do not necessarily mean the same thing. For example, would international certifiers regularly calibrate tree volume, taper and growth functions, and merchantable recoveries for every forest ecosystem, or monitor the quality of water, stream sedimentation and soil stability, or check that harvesting operations have not had adverse impacts on bird life in general, and so on?

Another major concern is that, if the monitoring is done by outsiders, their procedures are unlikely, to be compatible with an individual multi-resource inventory system as earlier discussed. The disadvantages and inefficiencies as a consequence of this inconsistency, or else duplicating the whole monitoring process (one for certification and the other for management purposes) is undesirable, particularly when costs of monitoring in the present and future environment are very much greater than has hitherto been practised. Fuller discussion of such issues are also covered in Lund [3]. Similar strategies for wood supply purposes are outlined in Whyte [7] [9] and [10] for a plantation production case.

CONCLUSIONS

This brief review suggests that neither researchers nor managers have yet come to grips fully with providinng objective evidence which demonstrate that forest ecosystems are being sustainably managed.

In the harvesting context which is emphasised here, it is recommended that greater consideration be given to:

- the design of integrated multi-resource inventory, monitoring and interactive modelling systems
  - setting clear coherent objectives for all parts of the whole management process
- providing management information systems from which evidence about the dynamics of forest ecosystems can be unequivocally deduced
  - enhancing interactions between managers' needs and researchers' priorities
- encouraging organisations to have their own programmes of monitoring operational performance and state of ecosystems, in addition to auditing and certification by independent outsiders
  - cater for multi-criteria decision-making involving all ecosystem stakeholders

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