

# **FRP project R7278, Humid and semi-humid tropical forest yield regulation with minimal data**

## **Report of a Training Workshop on Methods of Yield Regulation in Moist Tropical Forest with minimal data**

10 – 14 September 2001  
Oxford Forestry Institute, Oxford

### **Introduction**

A training course on methods of yield regulation in moist tropical forest with minimal data was held from 10-14 Sept 2001. The objective of the workshop was to provide hands on training in the use of the software in the MYRLIN toolbox to estimate and control sustainable yields at strategic, forest, and single stand level. In addition the workshop aimed to discuss issues relating to monitoring and control of yield, together with GIS methods for estimating forest areas, buffer zones, and preparing stock maps. The software was developed by Denis Alder.

The workshop was organised by Howard Wright and Nell Baker and the teaching was undertaken by Denis Alder. It was attended by 18 participants who currently work in Guyana, Brazil, Costa Rica, Ecuador, Argentina, Ghana, Cameroon, Uganda, Malaysia and Indonesia (see appendix 1 for list of participants). The participants were representative of the state forest services and the private sector including community forest management, universities and research organisations.

The first 4 days of the workshop consisted of training sessions and on the last day, in addition to further training sessions, a general discussion was held on information and research needs in yield regulation in all represented countries (see full programme in appendix 2).

### **Discussion of research needs in yield regulation**

Presentations were made by David Thomas and Miguel Romero followed by a general discussion of yield regulation and research needs. Miguel Romero gave a presentation on aspects of the forest management system implemented by his company in Northern Argentina indicating the problems they have with yield allocation and the ways that the MYRLIN toolbox will assist them (see appendix 3 for a full transcript of the presentations and discussion). David Thomas did the same for his work with local communities in the Esmeraldas region of Ecuador. The potential uses of the MYRLIN toolbox and the main research needs that came out of these presentations and the ensuing discussion were as follows.

### **Potential uses of the MYRLIN toolbox**

#### **Forestal Santa Barbara in Argentina**

The main goal of the company is to become certified and in order to achieve this goal reliable growth projections are needed.

Data is minimal because access is poor and there has not yet been enough time to plan inventories properly but PSPs will be set up in time. Data will be available next year from the first national inventory, prior to this no data has been collected at the national level.

- The MYRLIN toolbox will be used to estimate initial growth rates.
- The toolbox will be used differently for the montane and the transition forest.
- In the field the toolbox may be used to make predictions and then these will be checked on the basis of data obtained from harvesting operations. This data will be used to modify inputs into sections of the MYRLIN toolbox.
- MYRLIN may be used to assist in planning the location of a sawmill.

### **Esmeraldas community area in North West Ecuador**

Data is minimal because sufficient PSPs have not yet been set up. Recent inventory data is available for the whole area. Yields have been determined using simple stand projection based on 0.5 cm annual diameter growth. Communities would like to be able to maintain their revenue from timber and therefore require a reliable tool for the determination of sustainable yield.

- The project will use the MYRLIN toolbox to redefine the growth projections for the community areas and thus to come up with a more sensible annual allowable cut.
- In certain areas the project is also trying to create a more spatially oriented model using SYMFOR.
- David Thomas will also be involved in a regional planning exercise for the region of Esmeraldas. There has been no spatial analysis done in this area yet. He is thinking of using MYRLIN to propose sensible allowable cuts at a regional level.

### **MYRLIN uses identified in the general discussion**

- Putera Parthama said that in Indonesia they are planning to redesign most of the concessions in line with existing water catchments. Each concession will require a management plan. He was of the opinion that MYRLIN could help in the allocation of yields in these new concessions.
- It was noted that MYRLIN would not be appropriate for use where extensive PSP data is available – as in Ghana.
- Concern was expressed regarding the means by which certification companies assess the adequacy of yield allocation and regulation systems of companies applying for certification. It was pointed out that MYRLIN provides a relatively reliable and easy to use toolbox that could be used for this purpose.

### **Research and information needs**

- Some research on the usefulness of annual rings for growth prediction would be of value.
- It is hard to work with a fixed annual cut as the forest changes and the market changes. M Romero ended his presentation by requesting the production of guidelines for sustainable forest management that do not require or assume a fixed annual cut.
- The company (FSB in Argentina) is aiming for certification and is keen to meet all the requirements of this including the exploration of other commercial uses of the forest. The implication here is that there is a need to determine sustainable yields of products other than timber.
- Concern was expressed regarding the means by which certification companies assess the adequacy of the yield allocation and regulation system of companies applying for certification. There was concern that many certifiers may only have a rudimentary knowledge of yield regulation. Some research on the way that certifiers assess yield regulation might be useful.
- It was announced that the project (R7278) is planning to produce a ladybird guide to yield regulation and this was considered to be a useful development by all present.

### **Results of questionnaire on yield regulation**

Thirteen questionnaires on yield regulation were completed for each of nine countries. These were Argentina, Brazil, Costa Rica, Ecuador, Ghana, Guyana, Indonesia, Malaysia and Uganda. Participants from the same country worked together to complete the questionnaire for their country. The questionnaire covered details of the yield regulation system in their country, their personal role in yield regulation, their problems with yield regulation and their opinion of areas where information is lacking (see appendix 4 for the questionnaire and appendix 5 for the full results of the questionnaire).

The details of yield regulation systems in different countries and the roles of the respondents were compiled from the questionnaires. This first draft, however, is incomplete and there are still many questions that need to be answered about existing yield regulation systems. This is being attended to through email discussion and a report on this element of the workshop should be available at a later date. The following is a summary of the major problems faced in the process of yield regulation and the areas where information is lacking.

## Major problems in the process of yield regulation

These included the limitations of existing yield prediction tools (often with no standard system at the national level) as well as the problems of control of yield in the field (including illegal logging and corruption) and the lack of acceptance of guidelines by small loggers and forest owners. The lack of a national system for planning harvesting operations was also mentioned as a problem. The lack of PSPs and data on growth rates was a commonly expressed problem and, even where PSP data does exist, the high variation in forest conditions and the inconsistency of growth data were considered as problems.

## What information is lacking?

Many of the participants indicated that there was a lack of reliable information on growth and yield (6)<sup>1</sup> (including mortality and recruitment (1)) from PSPs and even a lack of reliable inventory data. Linked to this was the need to cover all forest types and conditions and the lack of information on mortality due to harvesting (2). Arising from the use of MYRLIN it was noted that there is a lack of information that is required to group species by growth patterns (1). Lack of information on yield regulation methods was also mentioned (2). In one case it was pointed out that existing land cover, vegetation class and forest land use maps needed updating to reflect changes. Others noted that GIS data and aerial photographs were lacking (2).

Lack of information and problems that relate directly to the specific roles of the respondents were as follows:

- Lack of growth and yield models or information on these (2).
- Lack of information on how to incorporate tree distributions into forecasting models.
- Lack of adequate software.
- Programmes need updating.
- Lack of time to devote to examining computer products and adapting them.
- Lack of literature on growth and yield estimation.
- Lack of tools for data analysis.
- Lack of ability to ascertain the accuracy and quality of results.
- Lack of accurate data (4).
- Lack of tools that can make species grouping easy, that can identify species from local names and that can create output for all types of forest in different locations or ecological conditions.
- Lack of general knowledge on computer programming.
- Lack of tools that are able to cope with huge data sets.
- Lack of information and expertise on database management and GIS.
- Lack of information on how to use GIS applications during stock survey and mapping.

## Existing and desirable training/operational material

Material	Existing information			Grand Total
	Basic	Intermediate	advanced	
GIS application	2	1	1	4
Growth models	1	1	0	2
Inventory manuals	1	2	1	4
Operational manuals	2	3	2	7
Statistical manuals	3	0	1	4
Theory manuals	2	2	0	4
Grand Total	11	9	5	25

<sup>1</sup> Figures in brackets indicate the number of questionnaires in which the relevant point was made.

Material	Information required			Grand Total
	basic	Intermediate	advanced	
GIS application	0	7	5	12
Growth models	4	7	4	15
Inventory manuals	0	2	2	4
Operational manuals	1	2	2	5
Statistical manuals	2	6	5	13
Theory manuals	2	3	5	10
Grand Total	9	27	23	59

## Assessment of the course by participants

The participants completed an assessment form on the training workshop the results of which are provided here.

### Course content

Most participants felt that the MYRLIN package will be very useful to them in their work particularly because it can be used where no PSP data is available (11)<sup>2</sup>. It was noted that MYRLIN complements other models already on the market and thus fills a gap (1). Many said that they were looking forward to attempting to apply MYRLIN to their own situation for forest management planning (5). One participant said that this course had helped him to feel more confident with handling data but that utilisation of MYRLIN would be best left to a 'systems analyst'. It was noted that the MYRLIN toolbox will be useful for yield regulation and for double checking field information (1). In addition one participant said that it would be very useful for teaching undergraduates and that he will introduce it into the curriculum in his University in Indonesia. It was noted that the toolbox will be useful for handling volumes of PSP and GISP data that have remained largely unanalysed due to lack of resources and know how (1). It will also be useful for providing information to stakeholders and to support policy and will allow participants to assist their Governments in making certain decisions (2). One participant noted that the course provided him with the initial knowledge on modelling of forest growth to permit him to start work in this specific subject. It was also noted that MYRLIN provided a very timely set of tools because yield regulation will be one of the most important topics in resource management in the future as timber supplies decline (1).

Participants said they gained new knowledge on the following:

- Data management (1)
- Species grouping (1)
- Calculating mortality (1)
- Creating a stand table (3)
- Cohort modelling or stand projection (2)
- Growth projection and yield modelling (8)
- Growth behaviour of species groups and growth estimation (4)
- Calibrating growth models and calculation of yield using minimal data (3)
- Using minimal data to the fullest extent (1)
- The use of excel and excel macros (9)
- The use of visual basic (1)
- Further understanding of general forest management (2)
- Yield regulation systems in general (4)
- Up to date knowledge of what is going on in other tropical countries in forest modelling (4)
- Possibilities for improving forest management back home (1)

Participants noted that the following areas were not covered and that they would have liked to have more information on these:

- More on modelling approaches in general to put MYRLIN into context (1).
- Explanation of the development of the D95 prediction tool (1).

<sup>2</sup> Figures in brackets represent the number of participants who noted a point in their course assessment questionnaire.

- Information on how to utilise MYRLIN output in GIS (1).
- Information on GIS applications (2).
- Information on how to introduce tree distributions into MYRLIN in order to reduce the error (1).
- Whether the model produces a stable population if there is no harvesting (1).
- How to incorporate economic factors into MYRLIN (1).
- Aspects of regression and statistical analysis of PSP data (1).
- Further manipulation of models (1).
- Yield regulation at the forest level (1).
- Projection of volume by stratum (compartment) (1).

## Course delivery

Most participants felt that the pace of the course was relaxed but good as it allowed time to digest all the new information and to do the practical exercises (8). Some participants felt that the course could have been faster to cover more content (3) but another felt it was a little fast as he had to struggle with the excel package and another felt the concepts behind the model were covered too quickly. Another felt that the course should have been longer so that they could have had more in depth coverage of model manipulation and GIS.

All felt that the structure of the course was clear and the standard of lecturing and presentation was high (11). Some noted that the fact that the model was changed during the workshop caused confusion (2). Many noted that there was a lack of documentation but were also aware that this would be produced in the near future and forwarded to them (9). One participant felt that more preparation of documentation would have helped to clarify certain points and others noted that the documentation that was provided was good (4). One participant noted that provision of literature on different methods of yield scheduling would have been useful.

All participants felt that they were able to get enough help during the course.

Some participants expressed the desire to build partnerships and share experience on the use of MYRLIN (3) and others said that they hoped they would be able to receive regular updates of MYRLIN, with support from the creator of the model (2).

## Workshop Logistics

Most felt that the organisation and running of the workshop was efficient and attentive, that the travel arrangements were good and the accommodation adequate or good (13). Some noted that the accommodation was half an hour from the workshop venue and it would have been better if it was closer (3). Two complained about the lack of some facilities in the shared accommodation.

## Acknowledgements

It had originally been planned to have a practical session on the use of a GIS system. We are grateful to ESRI UK for supplying a copy of their Arc View software. All participants were given material describing the system.

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## Appendix 2. Workshop programme

*Workshop presented by the Oxford Forestry Institute, Department of Plant Sciences, University of Oxford, 10<sup>th</sup>-14<sup>th</sup> September 2001, to be held at Oxford University Computer Service teaching laboratory, Banbury Road, Oxford.*

This workshop is designed as a hands-on training course in which participants will undertake practical work using the software in the MYRLIN toolbox to estimate and control sustainable yields at strategic, forest, and single stand level. Issues relating to monitoring and control of yield will be discussed, together with GIS methods for estimating forest areas, buffer zones, and preparing stock maps. Rules of thumb for volume, growth and yield estimation will be presented and applied in the practical exercises. Training will be given in spreadsheet methods of stand projection for yield estimation. The course involves a strong emphasis on practical assignments with Microsoft Excel and with ESRI ArcView-based GIS tools.

*Participants should be qualified professional foresters with experience of inventory, growth and yield in tropical forestry, and some background in the use of MS Excel or similar spreadsheet tools.*

## Workshop program

Date	Details	
Monday, 10-sep-01	am	<ul style="list-style-type: none"> <li>Registration, welcome address.</li> <li>Yield regulation concepts and the MYRLIN toolbox contents.</li> <li>Forest inventory, stock survey and other data sources</li> <li>Introduction to practical exercise with stand table module.</li> </ul>
	pm	<ul style="list-style-type: none"> <li>Practical exercises with stand table modules of MYRLIN</li> </ul>
	1730 – 2000	<ul style="list-style-type: none"> <li>Visit to OFI followed by reception in Halifax House (opposite OFI)</li> </ul>
Tuesday, 11-sep-01	am	<ul style="list-style-type: none"> <li>Basic growth projection methods and elements</li> <li>Diameter, basal area and volume increment</li> <li>Stand structure, increment and recruitment</li> </ul>
	pm	<ul style="list-style-type: none"> <li>Practical exercises with simple growth projection module from MYRLIN</li> </ul>
Wednesday 12-sep-01	am	<ul style="list-style-type: none"> <li>Estimating increment from static data</li> <li>Increment, mortality and size relationships</li> <li>Increment and ecological groups</li> </ul>
	pm	<ul style="list-style-type: none"> <li>Practical exercise in increment estimation from inventory data using MYRLIN tools</li> </ul>
Thursday 13-sep-01	am	<ul style="list-style-type: none"> <li>Yield regulation at the forest level.</li> <li>AAC, stock survey, log tracking and other control measures</li> <li>Pan-tropical increment comparisons and general AAC guidelines</li> <li>Strategic and policy implications of AAC estimates</li> </ul>
	pm	<ul style="list-style-type: none"> <li>Practical work on yield regulation at forest level</li> </ul>
Friday 14-sep-01	am	<ul style="list-style-type: none"> <li>Review of practical work and presentation of certificates</li> <li>Recapitulation: Application and adaptation of MYRLIN toolkit</li> <li>Demonstration of IwoPlan</li> </ul>
	1100-1230	<ul style="list-style-type: none"> <li>Group discussion of information and research needs in yield regulation in all represented countries</li> </ul>
	pm	<ul style="list-style-type: none"> <li>Demonstration of SYMFOR</li> </ul>



### **Appendix 3. Presentations and discussion of yield regulation systems and research needs**

Howard Wright invited Mr Miguel Romero to make a presentation on his situation in Argentina and how he thought he might be able to use the MYRLIN toolbox.

#### **Miguel Romero**

Miguel Romero works for a forestry company called Forestal Santa Barbara (FSB) based in the province of Salta in the North of Argentina. Unlike in many other countries where land often belongs to the state or to many communities, in Argentina all land can be owned privately. The mean size of farms in the Salta province is 3000 ha, and FSB has purchased several areas to date and now own about 100,000 ha.

The basic forest type in this area is called Yungas and is a continuation of the Brazilian Amazon forest. In the area of forest owned by FSB there are two main subtypes of forest, one is a transition forest between charcoal or dry forest and the other is montane forest (with the Andes to the West). Above the montane forest there is pine forest.

The montane forest is dominated by two main species: Walnut *Juglans australis* and a species of Cedrella, Spanish cedar. There are about 100 species in the transitional forest, only 12-17 of which have commercial value. Five of these species have high value. Both forests are completely different in terms of ecology and products.

FSB have conducted inventories in both areas (transition and montane) but this is not an easy task as access is only by helicopter so it is expensive. In addition there has not been enough time to plan the inventories properly because there has been a lot of pressure for quick information about specific areas.

Aerial photos taken in 1996 in colour at 1:16,000, providing a full coverage of the FSB owned area, were used to produce maps. The maps include contours based on the canopy, not the ground.

The MYRLIN toolbox could be used by FSB in many different ways. Firstly there is no growth information for the area, only some indication that some species grow faster than others so the MYRLIN toolbox will be used to estimate initial growth rates. Some investigation of the annual rings of Cedrella has been undertaken but this has not been done thoroughly for the whole area. The toolbox will be used differently for the montane and the transition forest. In addition the company will establish PSPs in the future. The company is aiming for certification and is keen to meet all the requirements of this including the exploration of other commercial uses of the forest.

In the field Mr Romero said that he was not sure how the toolbox will be of assistance but he thinks that they will use it to make predictions and then cross check these on the basis of data obtained from harvesting operations. This data will be used to modify the inputs into sections of the MYRLIN toolbox.

The company has not yet set up its production or trade plans. A sawmill is planned with driers and veneering capacity and MYRLIN may be used to assist in planning the location of a sawmill. Basically a full forest information system still needs to be established. This is important because forest management is a dynamic process, in five years time FSB will have more information but they will not have the final answer and plans will keep on changing. A model is a picture that is built to be close to reality but in order for the model to be close to reality one needs to continue to update it with information from the field. Overall the MYRLIN toolbox will be very useful for the company.

Legally the company does not need to present a management plan but must present a harvesting plan. They are required to do a 2% inventory and then fix the cutting cycle and the volumes for different species. These minimal legal requirements indicate that timber yield is not well controlled in Argentina and there is concern that the forest may be lost within 30 years if the control systems are not improved. The main goal of the company is to become certified and in order to achieve this goal reliable growth projections are needed.

The first question the company faced from Smartwood during an initial certification assessment was 'what is the estimated annual cut?'. FSB had to say that they did not know. However, they do know that it is hard to work with a fixed annual cut as the forest changes and the market changes. M Romero ended his presentation by requesting the production of guidelines for sustainable forest management that do not require or assume a fixed annual cut.

Ismail Harun asked if they have a national level inventory that they can use as a guide.

MR replied that the results of the first national inventory will be available this year. He added that they have volume functions for most of the timber in their area, these were produced by a UNDP project. However, the raw data is not freely available as the local person who was involved in the project is holding the data and is requesting a payment of \$10,000 to release it.

Denis Alder said that annual growth ring data will be very useful and could speed up the modelling process. Compared with PSP data collecting growth ring data will be quicker and cheaper.

MR said that they do have some data for growth rings but it is scattered and does not cover all site types. They have tried to obtain more annual growth ring data but have not found it easy as it has been difficult to access all the sites and fell trees in remote areas.

Howard Wright pointed out that rings are not always annual, so the method can be unreliable.

Ismail Harun noted that the first criterion for certification is the existence of a management plan, he asked if they had produced a comprehensive management plan including conservation and utilisation areas etc.

MR said that they had a comprehensive management plan that includes reserves for wildlife (alligators) and buffer areas along stream edges and adjacent to national parks etc.

IH asked what the AAC is based on at the moment.

MR said that it will vary in relation to different forest types, areas or properties.

### **David Thomas**

David Thomas works in the province of Esmeraldas in the NW of Ecuador. This is where two "hot spots" of biodiversity, the Chocó and the Western Forests of Ecuador, worldwide priorities for conservation, overlap.

The Sustainable Use of Biological Resources Project (SUBIR) works with tropical forest dwelling communities in the buffer zone of the Cotacachi Cayapas Ecological Reserve. The project is an integrated conservation and development project managed by CARE Ecuador and financed by United States Agency for International Development (USAID).

SUBIR works with Afro-ecuadorian and Chachi communities which have forests of 100-5000 ha. . These forests are managed both communally and individually. Farm forests are also common and are normally between 5-40 ha. Esmeraldas supplies about 60% of the ply logs in the country, mostly species of Moraceae and Myristicaceae. In the area that SUBIR works, about 40-60% of the commercial trees registered in stock surveys tend to be of one species, sande (*Brosimum utile*).

The main access to the communities is by river. Areas close to the river tend to be used for family farms and further from the river there is often a backdrop of family forest and then an area set aside for production forestry for the community. In addition, communities have designated a community forest reserve. The project is training community forestry promoters so that in the future they will be able to do monitoring and stock survey *etc.*

When starting in a new area the project will first do a rough Landsat interpretation to get an idea of the general pattern of land use. Local knowledge in combination with remotely sensed information is used to zone community lands. An integrated community land use plan is then developed. Recently topographical information became available for the area. The project has undertaken systematic

inventories in production forest areas and has a few PSPs (3-4). Yields have been determined using simple stand projection based on 0.5 cm annual growth. SUBIR aims to use MYRLIN to redefine the growth projections for these areas and thus to come up with a more realistic annual allowable cut. The project, through the work of Thorsten Jolitz, is adapting SYMFOR, in areas where sufficient information is available.

SUBIR is also involved in developing a regional management plan for natural resources. Hopefully it will be possible to use MYRLIN to propose sensible allowable cuts at a regional level.

Guidelines for tropical forest management were included as an annex to the forest law last year, incorporating requirements to reduce logging impact and for yield regulation. There is good support in the Ministry of the Environment to improve forest management and harvest practices. The latter have been largely uncontrolled in the past. There is also a lot of lobbying from NGOs. Dennis Alder asked if the project will be producing a specific forest management plan for the whole area.

DT said that each community needs a community management plan.

DA asked why they need management plans.

DT said that they are required by law to have a harvest plan and that in the past this was a formality. Now he says they are interested in maintaining their revenue from timber but he admitted that if the project had not got involved the local community would probably not be developing management plans at all.

Charles Dei-Amoah pointed out that in Ghana, in many cases, only a few people in a community know what is going on with regard to management plans and forest management and the rest know nothing, he wanted to know whether this was the case in Ecuador and how the community management is set up.

DT: In the community there is a forestry committee. In addition, on the governing body of the community, one person is nominated to deal with forestry issues. There is also a forestry promoter who is trained in technical issues. So there is a technical and a political person and they disseminate information at community meetings. But there are times when the communities don't know what is going on.

CDA pointed out that when livelihoods are at stake people are inclined to concentrate on working on their own farms. If they have no rights over the forest or no rights to arrest trespassers they will not spend time on forest management planning.

DT agreed that one of the initial mistakes made by the project was to think that all the people would want a role in forest management. So they started by working on an individual basis, on individual farms. But forest management is more of a community effort.

CDA wanted to know how the people log the forest.

DT said that this is done either manually or with small diameter cables. Logs are then either sawn in the forest or rolled to a river.

Howard Wright asked if there were any more questions on DT's presentation and then opened the debate asking whether we consider that yield regulation should be enshrined in legislation? And whether those who are responsible for making laws have the required information to do this?

Putera Parthama said that in Indonesia they are planning to redesign most of the concessions in line with existing water catchments. Each concession will require a management plan. He was of the opinion that MYRLIN could help in the allocation of yields in these new concessions.

HW asked if most forestry operations were undertaken under a concession basis and how long the concessions were.

PP said there is a problem here as they use a 35 year cycle but the concessions are allocated for 25 years. He said that one of the main problems was land tenure. There is a process of decentralisation currently taking place and many local people are claiming land rights.

NB asked whether they have the data and the knowledge of the species to use MYRLIN in this case.

PP said that they have inventory data available but that this may not be adequate.

HW asked if the certification guidelines explain how to allocate yield?

DA – said that no these are mostly qualitative guidelines, the individual certifiers have to be knowledgeable enough to pick holes in the methodology used by the certification applicant.

HW asked if we have experience of certifiers. He said he was concerned that many certifiers only have rudimentary knowledge of yield regulation.

DA said that he had done some certification assessments. He said that certifiers often get the wool pulled over their eyes.

PP-Said that in Indonesia that have the Indonesian ecolabelling. Appropriate yield scheduling is one of the most important criteria in this. Only 1 out of 100 concessions got certified based on these criteria.

DA noted that almost any enterprise that is examined closely can be shown to be over cutting. To go into certification properly the certifiers have to be willing to refuse many.

CDA pointed out that in Ghana they have a yield formula that is used to allocate yield from stock survey data. Trees allocated are marked on a stock map. He said that there were shortcomings to using MYRLIN for yield allocation in Ghana.

DA said that in Uganda they have a computer system that does stock mapping. This is not a technical problem. The only issue is getting from the field form to the digitised version and for this one needs a macro.

CDA asked if he could redesign the field sheet they use to suit mapping on computer?

DA – I am not sure what field sheet you use but it should be quite easy.

Ernest Foli noted that Ghafosim seems similar to MYRLIN.

DA said that Ghafosim is the same idea but distinguishes between the upper and the lower canopy. You could refine it a bit to have rules for the upper canopy and for the lower canopy. For upper canopy a good rule of thumb is: if any tree has a defect multiply its mortality by 3 and then reduce the mortality for the sound trees. The problem here is that with MYRLIN we are working from inventory data and not from stock survey so that rule of thumb cannot be used.

PVG brought the discussion back to the issue of certification in Indonesia saying that there was only one concession that was certified but even this is being challenged by a consortium that do not agree that the yield is sustainable. They say that the local criteria and standards are not strong enough.

The certification form includes a tick box asking if there is a management plan? A second tick box asks if one is applying the government management system. There is an assumption here that the government management system provides for sustainable yield but the evidence for this is not good enough.

He said that we should talk to the NGOs and let them know that now there is a simple tool (MYRLIN) that can be used for a quick answer to these problems for certifiers.

DA said that the UK certification has very high standards. There was a lot of detail put into this but there is a need for a two track system. There is a need to give some stars to those who are trying.

HW asked if the utility of MYRLIN increases as the area in which you want to use it increases?

DA – yes I think so but it should be seen as a first stage tool. If you are still using MYRLIN after five years then you are doing something wrong. It should not be considered a final solution to yield allocation.

PVG – noted that the aim of certification is to say that a forest is being managed according to best current knowledge and current best practice, the concept of constant improvement is key. If you have PSPs then you have a different entry point than another forest manager who has no growth data.

IH – Denis just mentioned that over logging occurs a lot. In Malaysia we have very strict rules on cutting, we allow the logger to cut anything above the cutting limit. In MYRLIN there are options to cut 50 or 100 % above the felling limit, but in Malaysia we feel it is dangerous to fix the cutting limit at a certain level as the loggers are likely to cut everything above that.

PVG – I agree and I will use that example this afternoon when I present SYMFOR. We then talk about the issue of not just yield prediction but also about yield regulation.

HW – we are planning to produce a ladybird guide to yield regulation, that is intended to be understandable by the layman and will include a lot about the dangers and advantages of choosing different management rules or logging rules. For example, what happens if you decide to log all the big trees, how does this affect the forest structure? What happens when you are short of trees in the middle range? What happens when there is a problem with recruitment or regeneration? We hope to produce this over the next 18 months.

PVG – one of the other things that will go into this guide will be a discussion of the possible systems. Many systems are based on diameter but there are alternatives. The trade-offs between different systems will be presented.

**Appendix 4. Questionnaire on yield regulation**

- 1. Name: .....
- 2. Organisation: .....
- 3. Brief job description: .....
- .....

**Part 1 Methods and responsibility**

- 4. Is there a common system of yield regulation? Yes/No
- 5. Are the methods similar for all situations – state forests, concessions, community forests and forest types? Yes/No  
*[If the answer is No then please give details for each situation on a separate form]*
- 6. Type of forest: .....
- 7. Who (or which organisation) is responsible for developing government policy and legislation for yield regulation?  
.....  
.....
- 8. What information and tools do they currently use?  
.....  
.....
- 9. Are there different levels of government involvement in the regulation of yield from forests, for example national and regional governments?  
.....
- 10. How do these groups differ in their responsibilities?  
.....
- 11. What information and tools do they use?  
.....
- 12. Who implements and monitors the policies and regulations?  
.....
- 13. What information and tools do they use?  
    At national level?  
    .....  
    .....  
    At regional level?  
    .....  
    .....

14. Who controls the yield in the field?  
.....

15. What information and tools do they use?  
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16. What technical methods are used? Give a brief description:  
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17. Are the methods well documented? Yes/No

18. Are the methods prescribed by law/regulation? Yes/No

19. Is a management level inventory a pre-requisite? Yes/No

20. Is a pre-harvest inventory demanded? Yes/No

21. Are there data available from PSPs (i.e. growth, mortality, recruitment)? Yes/No

22. Is use made of any type of growth or stand projection model? If yes give brief details:  
.....

23. Do the planned yield calculations and allocation have to be approved? If so by whom?  
.....

24. Is use made of a GIS in the yield regulation process?  
.....

25. Do you make use of any other tools?

.....

.....

26. What are the major problems in the process of yield regulation?

.....

.....

**Part 2 Information, tools, training**

27. What information is lacking?

.....

.....

.....

.....

28. Please indicate existing and desirable training/operational material

<b>Material</b>	<b>Existing</b>	<b>Would like</b>	<b>At what level?*</b>
Theory manuals			basic intermediate advanced
Operational manuals			basic intermediate advanced
Inventory manuals			basic intermediate advanced
GIS application			basic intermediate advanced
Growth models			basic intermediate advanced
Statistical manuals			basic intermediate advanced
Others(specify)			basic intermediate advanced

*\*Basic - for use by field teams/operators, sub-professionals, community workers  
Intermediate – for use by forest officers, technical managers/advisers in companies,  
etc. Advanced – specialists and research staff*



**Part 3 Your role in yield regulation**

29. What is your role in yield regulation?

.....  
.....

30. What information and tools do you use?

.....  
.....

31. What are the problems that you have that limit you ability to fulfil your role?

.....  
.....

32. What additional information and tools do you require?

.....  
.....

33. What additional training do you require?

.....  
.....

**Part 4 Any other comments**

## ***Appendix 5 Results of the Questionnaire on Yield Regulation***

### **Yield Regulation in Argentina**

This form was filled in by Miguel Alfaro Romero who is the forest manager for Forestal Santa Barbara. He is responsible for all forest operations 'from the stump to the mill'. He uses forest inventory, GIS and a lot of assumptions in his work. The main problems that limit his ability to do his job is the lack of growth data for most species. Quantitative information on growth rates and growth response are needed, therefore PSPs need to be established. He would like to obtain further training in GIS and in designing recurrent inventory systems and analysis of the resultant data.

The forest type in Argentina is subtropical.

Provincial Authorities under the Secretary of Natural Resources are responsible for developing government policy and legislation for yield regulation. The provincial government also implements yield regulation and monitors the policies and regulations.

At present no tools are used for doing any of these. No data from PSPs is available. There is no control of yield in the field. Basically the land owner is required to undertake a management level inventory and then present a 'harvest plan' to the provincial authorities which needs to be approved by the Secretary of Natural Resources. The harvest plan contains a list of species and volume to be extracted in a five year plan. No pre-harvest inventory is required. Control is undertaken only through checks on transportation from the forest to the sawmills, no control is undertaken in the field.

These methods are not well documented and are not prescribed by law.

One of the major problems in the system is the lack of information on growth rates and growth dynamics of the forest.

### **Yield Regulation in Costa Rica**

The form was completed by Mauricio Sanchez Monge who is involved in the regulation of the forestry profession in Costa Rica at the Colegio de Ingenieros Agronomos de Costa Rica (CIACR). His role includes training and supervision and he uses SIRENA and TREMA software. The main problems that limit his ability to fulfil his role include a lack of programmes and the need for revision and updating of existing programmes. He would like to have training on and access to databases and GIS.

The forest type is tropical rain forest and tropical dry forest.

In Costa Rica there is a common system of yield regulation and the methods prescribed are similar for all situations.

The Ministry of Environment and Energy (MINAE) is responsible for developing government policy and legislation for yield regulation. Standards for yield regulation are defined by a national special commission. Policies and regulations are monitored by MINAE and CIACR.

Different levels of Government are involved in the regulation of yield from forests. Basically felling licenses are approved regionally and general regulations are national.

The tools used for yield regulation include preliminary inventories, stock surveys and base maps. PSP inventory data are also available and the stand growth model SIRENA developed by Denis Alder is used. GIS is not used but Surfer (software for mapping) is used. The standards mentioned above are used for yield regulation and the monitoring process uses an evaluation methodology at the national level with reference to these standards.

Yield is controlled in the field by a forester who is required to be registered by the CIACR. They use preliminary inventory and stock survey information to allocate and control. A preliminary inventory is required of all species (both commercial and non commercial) including all trees over 30 cm dbh. A stock survey of all species greater than the minimum felling diameter is also required. Only 60% of the latter can be harvested. A felling cycle of a minimum of 15 years is defined by law.

These methods are not well documented but they are prescribed by law, i.e. the interpretation of law into practice is not well documented.

The major problems in the process of yield regulation include difficulty in controlling yield in the field and the corruption of public employees. Information that is required is a national system for yield regulation and planning of harvesting operations that is sensitive to the timber market. Tools to control yield at the FMU level are also required.

## **Yield Regulation in Ecuador**

The form was completed by David Thomas who is a Community Forestry Advisor for the Wildlife Conservation Society, CARE. He is involved with an NGO that has provided support to the Ministry of the Environment in its work with communities that are involved in forest management and require yield regulation proposals. He will also be involved at the regional level in making simple stand projections using Excel. The main problem he experiences in fulfilling his role is lack of time. He believes that MYRLIN is going to be a useful new tool for him in his work. He would like further training on linking a simple tool like MYRLIN with GIS at the regional level and where applicable (i.e. where there are data) linking with a more complex modelling tool.

The forest type is Moist Tropical Forest.

There is a common system of yield regulation but it is new and at present needs much refining. Methods are similar for all situations.

The Ministry of the Environment is responsible for developing government policy and legislation for yield regulation. It is also responsible for implementing and monitoring the policies and regulations.

Up to December 2000 the forest law, albeit requiring management or harvest plans did not regulate yield. Guidelines were drawn up in a painful consultation process involving the Ministry, NGOs and the private sector, for harvesting in tropical forest. Restrictions aimed at regulating yield include:

1. minimum cutting cycle of 15 years,
2. maximum basal area harvested of 30 % or 40% with silvicultural treatments,
3. restricted harvesting of less abundant species based on inventory and stock survey information down to 30 cm

Other restrictions aim to facilitate a reduced impact harvest. These guidelines are a first step in the process to implement rational forest management. Many improvements are needed. For small areas or non mechanized logging a simpler option is in force.

Different levels of government are involved in yield regulation. National Government develops policy and provides training. Regional Government forestry offices (Regentes Forestales) implement the policy.

The tools used for yield regulation include information from forest inventories and a computer programme that has been developed for data processing and allocating harvest.

Yield is controlled in the field by an independent forester with the Regentes Forestales. Yield calculations and allocation have to be approved by the Regentes Forestales and the Ministry.

An initial inventory is not always required but a stock survey to 30 cm is always required. No PSP data is available and no use is made of any growth or stand projection models. GIS is not used but the respondent makes use of an access programme for inventory and stock survey data.

The methods are prescribed by law and are well documented.

The major problem faced in this process is the acceptance by small loggers and other forest owners of the new guidelines. The main information lacking is PSP data and growth projections.

## **Yield Regulation in Ghana**

This form was filled in by Charles Dei-Amoah of the Forestry Commission (FC), Ernest Foli of the Forestry Research Institute of Ghana (FORIG) and Francis Odoom.

Charles is responsible for the endorsement of timber yields to contractors. He uses stock survey information and logging plans and refers to the manuals of procedures for yield allocation and the logging manual. The main problems that prevent him from fulfilling his role include difficulty in ascertaining the accuracy and quality of

submissions from contractors and the fact that the formula for yield regulation needs to be reviewed as it has been interim for the past 10 years. He would like to have access to GIS applications for stock survey and mapping. He would like to have training in GIS use, quality assessment and in the development of yield formulae. I.e. training geared towards solving the main problems he faces in his work.

Ernest Foli is responsible for PSP and GISP data collection and analysis. He uses data from established research plots. The main problems that prevent him from fulfilling his role are inadequate facilities and limited financial resources and logistical support. He would like additional literature on growth and yield estimation in moist tropical forest as well as tools for data analysis. He requires further training in programming and advanced modelling techniques.

In Ghana there is a common system of yield regulation but methods differ for different situations. There are different methods for community forests and forest reserves. Yield from community forests is regulated according to a quota system. In addition the normal yield formula applies to the moist and wet tropical forest and a reduced formula is used for dry forest.

The Ministry of Lands Forestry and Mines is responsible for developing government policy and legislation for yield regulation. Yield is regulated at the national level as well as at the FMU level. The Forestry Commission is responsible for monitoring policies and regulations.

The tools used for the development of yield regulation policies include inventory records from both permanent sample plots and temporary sample plots, harvesting records and trade statistics. In addition stakeholder consultation and short-term consultancy services are used. Growth, mortality and recruitment information is available from PSPs but this is inadequate. A growth model, Ghafosim, developed by Denis Alder, has been used to analyse growth characteristics of the high forest but results for such an analysis have not yet been used to alter the yield allocation system.

Tools used for monitoring at the national level include stock survey, harvesting records, input/output analysis and spot checks. At the regional level tools used for monitoring include stock survey, post harvest records and compartment assessment reports.

The Forestry Commission District Managers and their Range Assistants control yield in the field. To do this they use logging rules and regulations, the logging manual, post harvest checks and compartment assessment reports.

The procedures for yield control include the following. Harvesting schedule preparation (primarily based on national inventory data) and compartment inspection by the forestry commission. 100 % stock survey by the concessionaire. Check survey, stock mapping, logging manual preparation, yield selection according to the yield formula, yield mapping and yield approval prior to felling by the Director of the RMSC forestry and the Forestry Commission Regional Forest Manager. The concessionaire undertakes harvesting operations and the Forestry Commission District Office undertakes a post-harvest check GIS is not used in this process.

These methods are well documented, they are governed by forest laws but are not prescribed in detail by law.

One of the major problems in this process is the cumbersome nature of manual selection of yield from the stock survey maps and the preparation of yield maps. In addition the formula for yield allocation needs to be reviewed as it has been interim for over 10 years. There is a lack of reliable PSP data adequate for determining a sustainable yield.

### **Yield Regulation in Guyana**

This form was completed by Mr Jagdesh Singh and Mr Tasreef Khan both of whom work for the Guyana Forestry Commission. Mr Singh's role is to compile, analyse and disseminate information and Mr Khan's role is to implement and carry out forest surveys as required as well as to process the resultant data. They use inventory data and GIS, but the whole system is still in its infancy. The main problem that limits their ability to fulfil their roles is the lack of a growth and yield model. They require additional software and would like advanced training in growth and yield modelling.

The forest in Guyana is mixed tropical evergreen forest.

In Guyana a common system for yield regulation is under development. At present yield regulation systems differ for different forest types and the log tracking system utilised in the SFPs is being extended to concessions but not to Amerindian lands.

The Guyana Forestry Commission is responsible for developing policy and legislation for yield regulation in SFPs and TSAs but does not cover the Amerindian lands. The information they use is based on research studies and tools include the Tropenbos Silviculture System and the SFP rapid assessment. Different GFC officers are responsible for regulating the yield of TSAs and SFPs based on the forest law and the CoP. The GFC implements and monitors the policies and regulations and the EPA also has a limited role in monitoring.

The tools used for implementing yield regulation include the CoP, log quotas and management plans that usually are produce annually.

In the field yield is controlled by the concession holders and GFC monitors this against guidelines. The GFC uses the SFP-research assessment programme, silviculture surveys and log tagging systems to monitor yield in the field. Management level inventories and pre harvest inventories are required and GFC have to approve management plans and the yield calculation (based on the quota system, see below).

Basically stand projection spread sheets are used for estimating sustained yields, using increment and mortality estimates from PSPs. These are used for policy purposes not for regular yield determination. The CoP lists criteria that must be followed in selecting and extracting yield. It specifies diameter limits, minimum distance between harvestable trees, maximum logging intensity and buffer zones. The log quota system specifies

- a 60 year felling cycle limiting the yield to 20m<sup>3</sup>/ha/cycle,
- only 80% of the productive area should be harvested,

- includes a formula for calculating the number of trees/ha/cycle that can be harvested.

These methods are well documented. The law covering this is currently in draft form.

The main problems in the process of yield regulation is that there is currently no standard system and there is a lack of PSP data for some parts of the country. In addition illegal logging is a problem. Further information is required on yield regulation models.

## **Yield Regulation in Indonesia**

This form was filled in by Mr Putera Parthama, Mr Ridwan and Mr Redhahari.

Mr Redhahari works for the Forest Planning Laboratory in the Forestry Faculty of Mulawarwan University. He is a laboratory assistant involved in teaching undergraduates how to analyse forest data. He also undertakes some consultancy work for the private sector. His main objective in work is to assign an equal volume per year from a single area. He uses satellite imagery, stock survey data and potency (potential yield). The main problems he encounters are a lack of information on tree distribution and how to compare this with potency. He requires more information on spatial modelling of forest growth and yield and how to link this to RIL, how to design inventories to collect the relevant data for this and how to analyse the data. He requires further training in yield regulation for small stakeholders (such as community forests in small areas), he also requires further training in GIS at an advanced level and general training in sustainable forest management.

Mr Ridwan works for Bengkulu University as a teacher in the Forestry Department. He is also an executive director for the Juvenil Sejati Foundation which is an NGO involved in community forestry. His main role in yield regulation is the control of production using RIL and the application of regulations that differ for different types of forest or Island. He uses primary and secondary data from PSPs and uses Symfor. The problems that limit his ability to do his work are limited data, poor accuracy of data, poor access to data and a lack of clear understanding of the underlying equations in forest growth models. He requires more written material relating to these problems, more field data and more GIS and remote sensing data. He would like to have further training in growth, mortality and recruitment processes in order to understand yield modelling. He would like training that would enable him to create a simple model with simple equations using simple data for each type of forest in Indonesia.

Mr Putera Parthama works for the Forest and Nature Conservation Resource and Development Centre. His job involves planning and evaluation of research and development projects and the activities of the Centre and its subsidiaries. His role in yield regulation involves providing, adapting or recommending methods, techniques or tools for yield regulation. He uses growth and yield models, simulation models, and forest inventory information. All of these are site-specific. The main problem that limits his ability to do his work is that data for growth and yield predictions is still very limited. He does not require further training.

The main forest types in Indonesia are wetland tropical rainforest and dryland tropical rainforest.

Forest policy and legislation is developed within the Ministry of Forestry by the Directorate General of Production Forest Utilisation in coordination with the Forestry research and Development Agency. The tools used for this are formulae applied to inventory data and assumed growth rates.

Different levels of Government are involved in different aspects of yield regulation. Policy is developed at the national level and implementation, i.e. allocation and control of yield is undertaken at the regional level. A process of decentralisation is currently underway.

The Forestry Department is supposed to undertake forest inventory every 5 years and growth is calculated to be the difference between years. Since 1994 every concession is required to establish PSPs and growth is calculated from the PSP data. However, good quality PSP data is not available for the whole country.

Policies and regulations are monitored by the Forestry Department under the Ministry of Forestry. This work will soon be decentralised to local forest offices. Monitoring at the national level is based on annual reports from each region. At the regional level monitoring is based on reports of the H&H which are checked using sampling inventories.

According to Putera the yield is controlled in the field by the managing companies (concession holders) whereas Ridwan and Redhahari report that this is controlled by the Forestry Department. The latter note that the FD determine the potency of the standing stock to control yield, explaining this as follows (which I do not understand). From the AAC – compare between area and potency; then do sampling potency inventory (1-5%) in the block for next harvesting. If the average potency/area equal or +/- 5% still acceptable; if it doesn't fit to that range the forest concession re-inventory again or their AAC approved by reducing the m3 they asked – based on/ compare to the result from forestry department team. *I think this means that the concessionaire is required to undertake a 100% (?) inventory of all commercial trees (?) and then calculates the yield and submits this for approval. The forestry department do a 1-5% inventory of the blocks that the concessionaire has submitted for harvesting. If the FD inventory agrees with the results the concessionaire presented (a 5% difference in results is permitted) then the yield requested is approved. Otherwise the yield has to be reduced or the concessionaire has to reinventory.* A management level inventory is also required.

There is some confusion over the use of Growth and yield models. Some large concessions use GIS to allocate yield. Some other tools are also used.

The methods described above are documented but not very well and they are prescribed by a Ministerial decree.

The main problems in yield regulation are the limitations of yield prediction tools and the high variation in forest conditions. In addition there are no land cover maps and vegetation class maps at the regional or national levels. The forest land map needs to



be revised as many changes have occurred since the last map was prepared before 1997. Growth and yield information is need for each forest type and condition.

### **Yield Regulation in Malaysia**

This form was completed by Ismail Bin Harun of the Forest Research Institute of Malaysia. His role is to provide information on growth and yield and to estimate cutting cycles, maximum harvest and optimum growing stock. He uses permanent sample plots and computing to do this. His ability to fulfil his role is limited by his knowledge and his programming skills. Additional tools he requires are those that can deal with huge data sets. He would like to undergo advanced training in growth and yield analysis and computer programming (he will also require training in advanced statistics and data processing).

The forest type in Malaysia is Tropical Moist Forest (Dipterocarp forest).

A common system of yield regulation exists and the methods are similar for all situations.

The Ministry of Primary Industries (comprising the Forestry Department and the Forest research Institute) is responsible for developing Government policy and legislation for yield regulation. The Forestry Department is also responsible for monitoring the policies and regulations and for controlling yield in the field.

Different levels of government are involved in yield regulation their responsibilities differ in the size of the area covered. At state level yield is allocated to each forest management unit (FMU) by the state forest departments, the yield at the national level represents a total of the FMU yields.

The tools used for yield regulation include national forest inventory undertaken every 10 years and a management inventory that is undertaken for each concession in order to prepare a management plan. No specific tools *are used for yield allocation as concessions are divided up into equal areas. The number of areas depends on the felling cycle and each year one area is harvested in accordance with harvesting rules.* Certain concessions have special programmes or models to allocate yield.

Management level and pre-harvest inventories are required and data is available from PSPs. GIS data is not used.

Growth and yield data is being used to determine cutting cycles, maximum harvestable volume and growing stock. Yield calculations and allocation have to be approved by the Forestry Department.

The tools used for controlling yield in the field include manual and computerised log shuttle returns on a monthly basis.

The tools used for implementing monitoring policies and regulations at the national level include national forest inventory and manual calculations based on area and rotation. Tools used at the regional level include forest management inventory and

manual calculations based on area. Certain concessions make use of computer programmes.

The methods outlined above are prescribed by law and they are well documented.

The main problems with the process of yield regulation are inconsistencies in growth data and resultant inconsistencies in growth behaviour.

Information that is lacking includes:

1. Species grouping according to growth behaviour.
2. Modification of MYRLIN programming to suit each country requirement.
3. Volume calculation not included (should allocate ability to include and to modify volume function easily).

## **Uganda**

This form was completed by Steve Amooti Nsita of the Forestry Department. He is involved in resource management at the national level and also in a natural forest management and conservation project. He is responsible for data collection, processing and issue of licences for harvesting plus the monitoring of field operations. He uses EI and ISSMI (Integrated Stock survey and management inventory to collect data and produce stock maps and stand tables for monitoring.

The forest type in Uganda is tropical high forest.

There is a common system for yield regulation which applies to state forests and concessions but does not apply to private and community forests. The Forestry Department is responsible for developing government policy and legislation for yield regulation. The tools used for policy development are exploratory inventories, stock survey and management inventories. PSP data is available but is not up to date for all forests. No use is made of stand projection models.

Different levels of Government are involved in yield regulation. The FD HQ determines the AAC and prepares stock maps of harvestable trees. The local forest offices supervise harvesting and data collection. The FD HQ use computer applications for EI and ISSMI data processing. At the reserve level stock maps and yield tables are used.

The Forestry Department HQ implements and monitors the policies and regulations. Stock maps and license conditions are used for this purpose.

Yield is controlled in the field by the District Forest Officer and Forest Officer in charge of a particular reserve. They use stock maps and license conditions to control yield in the field. The process of yield control is as follows. An exploratory inventory of 1% determines whether a forest or parts thereof can be harvested (min 20-25 m<sup>3</sup>/ha). An integrated stock survey and management inventory (ISSMI) in harvest areas is undertaken to map trees that can be harvested (all trees  $\geq$  50 cm dbh are mapped) and to collect data on quality of stem and condition of forest (i.e. whether it has been affected by fire, encroachment, climber infestation etc.). Computer assisted

processing of stockmaps is undertaken to produce stand tables and yield tables showing harvest and seed trees, volumes by species etc. This is all undertaken by the FD. A management level inventory is required but this is not always done. GIS is used for fixing the block lines for EI and ISSMI.

These methods are well documented but not published, they are prescribed by Departmental Standing Orders that are supported by law.

The major problem in this system is the lack of PSP and other data to determine mortality, recruitment and increment.