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Local
Adaptation and
Calibration

Evaluation and documentation of the process

FLORES Team Zimbabwe with contributions from Edinburgh, World Forests, Southern Cross and Bangor

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School of Agricultural and Forest Sciences,
University of Wales,
Bangor, Gwynedd

May 2001

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FINAL TECHNICAL REPORT

Project No: R7635
Project Title: Integrated use of agroforestry models to support policy formation

Executive Summary

Interactions amongst people and natural resources at forest margins represent a complex policy domain both because of the diversity of human actors in the landscape and the mosaic of land use. Interactions amongst people and natural resources are fundamental to sustaining livelihoods. The miombo region in Africa covers 3.6 million km^2 and supports 65 million people, mainly in near subsistence agriculture, as well as a unique ecosystem with important wildlife and a sizeable ecotourism industry. Miombo woodland has been described as social forest, because of the rich interactions between people and the tree cover which maintains the ecosystem integrity. Close to 80% of miombo is under small scale agriculture, with fuelwood and charcoal supplying the energy needs of both the rural and urban population. Increasing population and requirements for higher consumption, if poverty is to be eliminated, threaten the sustainability of the miombo system, unless the exploitation of natural resources can be effectively managed.

In striving to develop appropriate community based management of natural resources, organisations in the NGO and governmental sectors, working both with local communities and governance structures at one end, and seeking to influence national and regional policy at the other, articulated a widespread demand for tools to explore the long term consequences of short range decisions affecting land use, tree cover and resource exploitation. During this project, several organisations in Zimbabwe (such as SAFIRE, WWF, and the CIFOR adaptive collaborative management team) have acquired capacity to build locally relevant simulation models of forest margin landscapes. They have developed participatory models, involving relevant stakeholders in the model development process, so that there is local ownership and confidence in them as decision support tools. Models generated in this way form a solid basis for negotiating regulatory frameworks, identifying commercialization pathways and evaluating likely impacts of alternative policy options.

This has been achieved by institutions in Zimbabwe adopting the FLORES Local Adaptation and Calibration (FLAC) package developed and promoted in this project. The FLAC package comprises the Simile modelling environment, a training model of a forest margin landscape including human and biophysical components, a library of submodels and a training manual that describes how to go about the modelling process. The manual takes new users step by step through the model development process dealing with everything from simply calibrating an existing model to local conditions, to developing a new model from scratch. Evaluation of how organisations have used the FLAC package, revealed that even people with little or no previous modelling experience were able to quickly develop competence and then chose to implement simulation models in the course of their work. The simple and intuitive modelling environment can facilitate participation of a range of stakeholders in the modelling process, from community groups to government officials. Adoption of a participatory modelling approach has already impacted the type of interactions that development organisations are having with local people and the type of information that they are collecting to assess natural resource management issues. Impacts on policy are anticipated in the miombo region and other forest margin contexts further afield in West Africa, Indonesia and Latin America where the approach has also been adopted.

Background

Food security, rural poverty and the conservation of biodiversity are inexorably linked to land use decisions made by local communities. These decisions, in turn, are influenced by incentives, regulations and policies formulated by outside agencies. These policies originate from a number of sources, including the agency's own agenda, public pressure, and the input of other agencies such as NGOs. In formulating policy, agencies need to assess the likely impact of alternative policy options, choosing the ones that are most likely to produce desired results. This is difficult at the best of times, given the complex web of interactions within rural communities: it is even more so in a world where social, economic and environmental circumstances are changing at an unprecedented rate. Although much research has been undertaken into the biophysical and social aspects of rural agriculture and forest-based systems, a major constraint on the ability of agencies to formulate optimum policy is a disjunction between the outcome of research (complex relationships and caveats, for partial systems) and what policy-makers actually require (clear statements of cause and effect for whole systems). Local development of FLORES models aims to address this constraint, by integrating diverse forms of research knowledge in a tool for enabling policy-makers and decision-takers to predict the impact of policy decisions on the livelihoods of people in rural communities at the forest margin and the status of the resources on which their livelihoods depend.

Previously, research on developing FLORES models had shown that it was possible to produce simulations of forest margin landscapes, including the key interactions between human and biophysical components. In the present project the aim was to apply this approach in a real forest resource management context with the sort of people and organisations who need to be able to develop and use decision support tools in the course of promoting sustainable management of natural resources. A strong demand for integrative tools to address complex natural resource management issues in the miombo region of central and southern Africa had been identified and so Zimbabwe was chosen as a testbed for developing a FLORES Local Adaptation and Calibration package aiming to make it possible for individuals and organisations to develop skills in building locally relevant simulation models.

Project Purpose

The purpose of the project was to improve policy formation at the forest/agriculture interface by providing organisations involved in the policy development process with integrative decision support tools. The key aspects of integration required were twofold. Firstly to integrate across disciplines, and specifically to include explicit representation of social dimensions of natural resource management and their interactions with ecological dimensions. Secondly, to integrate perspectives of a range of stakeholders in the development of decision support tools to address the diversity of actors and objectives impacting and depending upon natural resources.

Research Activities

The research activities comprised:

- an inception workshop in Zimbabwe (pp 1-4) to identify participants and characterise the policy process that decision tools were to be designed to influence,
- the development of a FLORES Local Adaptation and Calibration (FLAC) package (Muetzelfeldt and Taylor, 2001)
- three training workshops (pp 5-13, 15-29 and 47-69) at which participants used the FLAC package to acquire the relevant skills and develop locally relevant models, and
- evaluations of both the FLAC process and materials and the usefulness of the resulting models (pp 83-93).

A full record of these activities is appended and the results and lessons learned are summarized in the section on outputs below.

Outputs

The outputs from the project were:

- the development and promotion of the Flores Local Adaptation and Calibration (FLAC) package,
- the modelling activity of participating organisations in Zimbabwe and its impacts upon their work in policy development related to miombo resources, and
- evaluations of both the FLAC package and the utility of the modelling activity that was undertaken by the participating organisations.

Key aspects of each of these outputs is briefly summarized below and described in more detail in the attached record of the project process.

A FLORES local adaptation and calibration (FLAC) package was developed and promoted in conjunction with users in Zimbabwe. This comprises the Simile modelling environment (modified during the project to meet users needs), a training model used as a template for developing landscape level models, a library of submodels and a set of lessons covering how to go about model development.

It is delivered as a software package and accompanying training manual. This employs a top down approach to building capacity in modelling, starting with a working model at a plausible scale and level of complexity for addressing resource management issues. This allows users to obtain model output from the outset, and in a step by step fashion, learn how to modify models to make them locally relevant.

Several models relevant to resource management of miombo woodland are under development by collaborating organisations in Zimbabwe. The Adaptive Collaborative Management (ACM) team led by CIFOR have developed a FLORES model focused on three villages and the surrounding landscape in Mafungautsi state forest in Gokwe district. WWF are developing a model of impacts of fuel price and availability on wood cutting around urban centres initially in Zimbabwe but to be extended to charcoal production in Zambia in due course. SAFIRE are developing models of commercialisation of non-timber forest products relating extraction rates to livelihoods and resource status that will be used to negotiate extraction quotas with village resource committees. Further afield the approach has also been adopted by IITA in a humid tropical forest context in West Africa, CATIE in Nicaragua and Costa Rica and CIFOR in East Kalimantan, Indonesia.

The utility of the FLAC package was evaluated through surveys of users in the first training workshop (pp 8-13), recording of the proceedings of subsequent workshops (pp 15-29 and 47-69) and a series of discussions with users at the end of the process (pp 83-93). A range of people from government and non-governmental organisations dealing with natural resource management issues, some with no previous experience of modelling have become proficient in implementing models. Feedback from them has been incorporated in improvements to the Simile modelling environment and the FLAC training materials. There would be merit in the future in expanding the FLAC manual to include new sections on traversing scales and achieving effective participation by stakeholders. Development of new capacity in participatory modelling is likely to require some input from experienced trainers in addition to the FLAC materials and involve sufficient institutional investment to ensure a critical mass. The fact that a range of organisations have incorporated a modelling approach within their work and are now using this as a central plank of their activity is a solid endorsement of the utility of the package.

The usefulness of FLORES models for influencing policy was evaluated by characterising the policy formation process at an inception workshop (pp 1-4) and then discussing model utility with individual clients in an evaluation week (pp 83-93). Tools for exploring resource management options are required at a range of scales to be used by various actors in the policy development process. At smaller scales and earlier in the policy development process, the emphasis is on understanding resource management problems and opportunities, whereas at larger scales and later in the process the emphasis shifts to exploring the possible consequences of alternative options. Participation of stakeholders in model development links these scales. Use of simulation models centres on local, national and international organisations who interact on the one hand with local communities and on the other with policy makers in government bodies. Even in a short time, impact on the early stages of policy formulation and the behaviour of some of the actors in this process was evident. Key impacts have been:

- fostering interdisciplinary collaboration,
- development of more explicit consideration of the social dimensions of natural resource management decisions,
- clarification of the definition of key policy issues and the cause and effect relationships contributing to them, leading to
- changes in how organisations interact with local communities, specifically in terms of the information collected as a basis for evaluating resource management issues.

The next stages are to test and then run models together with stakeholders which WWF and SAFIRE have plans to do within the course of their work and the CIFOR ACM team have funds for a further year of work on the Mafungautsi model The effectiveness of this stage will depend heavily upon the range and quality of input / output tools available within the Simile modelling environment and the ease with which they can be customized. This merits further participatory development of user interfacing, driven by the requirements that emerge from using the models in real world contexts.

Contribution of Outputs

The project outputs have been achieved and emphasis has shifted from an initial concept of a generic forest simulator used by high level policy makers to suites of simulation models at various scales developed in a participatory way with relevant stakeholders by NGOs and government organisations influencing the policy process. It is anticipated that this will improve livelihoods of poor people through sustainably enhanced productivity of forest resource systems because it will allow client organisations to address complexity of interactions between people and resources at the forest margin and improve the basis for negotiation of resource use by various stakeholders.

The participating organisations in Zimbabwe and further afield all did so because they had a demand to develop integrative decision support tools in the course of their ongoing development activity in promoting sustainable, community-based, natural resource management. These organisations all have plans and at least some resources to continue these developments. A large regional project to develop and apply decision support tools in the miombo region is in preparation. The FLAC package (Muetzelfedt and Taylor, 2001) is available both in hardcopy format and electronically at the FLORES website.

References

Muetzelfeldt R. and Taylor, J. 2001. Flores Local Adaptation and Calibration Training Manual. Institute of Ecology and Resource Management, University of Edinburgh, 197 pp.

Record of the FLAC inception workshop, Thursday 4th May, 2000

Fergus Sinclair

Introduction

The inception workshop was held in Harare on the 4th May, 2000 following the Gwai modelling workshop, which had been funded and was reported separately (Vanclay *et al*., 2000). The purpose of the inception workshop was to identify whether there were clients in Zimbabwe, who wanted to use simulation models in the process of policy formation and if so, what their requirements were, and then to plan project activity to meet these requirements. It also provided a baseline in terms of the current way in which policy is formulated and how modelling is used, if at all, to influence it.

The programme of the meeting was as follows:

Co-chairs Elias Ayuk (ICRAF) and Peter Frost (IES)

09.00 - Introduction (chair)
09.20 - What is FLORES? (Jerry Vanclay)
09.50 - What is Simile? (Robert Muetzelfedlt)
10.30 - What happened at the Gwai modelling workshop (Ravi Prabhu)
11.00 - Coffee
11.15 – The FLAC initiative (Fergus Sinclair)
11.30 - Roundtable
participants discuss their activities, information needs, and reactions to the FLORES concept
12.15 - Discussion of the way forward (participation and schedule of activities)
13.00 - Lunch
14.00 – Optional Hands on session with Simile for those interested
(Robert Muetzelfeldt)

Outcome of the roundtable discussion: is there a demand for model development?

CIFOR and ICRAF having had senior staff taking part in the Gwai workshop had previously articulated their demand. CIFOR within the context of their adaptive collaborative management initiative, wanted to develop decision support tools to assist in joint management of forest resources, together with a range of stakeholders, including other organisations, such as the Forestry Commision represented at the present workshop. ICRAF were interested in spatially explicit representation of resources and processes at landscape scales. The key requirements of the other participating institutions were as follows.

SAFIRE

The Southern Alliance For Indigenous Resources (SAFIRE) is a Zimbabwean NGO with a regional mandate and collaboration with organisations throughout southern Africa. It is concerned with sustainable use of natural resources within the context of developing rural livelihoods. Primary activities are associated with community based development. Their interest in modelling is that they need to be able to develop tools to predict implications of change. Change encompasses both interventions being introduced in the development process (for example, exploring the consequences of commercialisation of a non wood forest product on household income and future status of the resource over a 10-20 year horizon) and externally induced changes which are affecting livelihoods (e.g. impacts of shortages in foreign exchange driving up fuel prices on a 1-5 year horizon or of HIV/AIDS on family labour profiles and resource use in a 5-25 year horizon).

IUCN

The World Conservation Union (IUCN) is a union of government and non-governmental organisations. In Zimbabwe they are developing methodology for ecosystem well being associated with human well being. This embraces a rural livelihoods approach with both ecosystem and human dimensions. They require tools for identifying indicators of what is happening to the condition of the resource base and how people are benefiting from it. Models are required to predict in a spatially explicit context the impacts of different interventions on chosen indicators. They have been exploring the use of mapmaker but this does not allow multiple layering, that is, superimposing different layers on a spatially explicit landscape representation.

Forestry Commission

This is a national government institution. Their interest in modelling is to assist with the introduction of new species to farm land and the management of trees already within smallholder farm systems. They are interested in understanding how trees impact on farmer decisions and what determines key farmer decisions (e.g. to plant trees, remove them or engage in tree management). Specifically they want to develop models that can predict the impact of their initiatives on farmer decisions.

WWF

The World Widelife Fund (WWF) is an international NGO. They are concerned with community based resource management and are interested in models at village, community, ward and district level. They are particularly interested in the development of decision support tools at a local level. They suspect that cause and effect of land use change and its impact on rural livelihoods and nature conservation, at landscape scale, are not well understood and that there are prevailing misconceptions held by decision makers. At a Southern African Development Community (SADEC) level indicators are looking bad (25% decrease in per capita food production in the region) making action to sustain rural livelihoods crucial and urgent. A simulation tool is desperately needed – WWF are facilitators of decisions – they try and help people make decisions. The biggest challenge is getting a longer term perspective involved in the decision making process, so that people can realise that there are long term consequences of their short range decisions. The macro-economic environment is very important in shaping decisions. The kinds of decisions that are important are those regarding: settlement options (where, who and how many people settle), quotas of animals, costs of tenure and associated rules. Also of particular importance is institutional change – and particularly understanding when and under what conditions institutions are likely to change (e.g. from common pool to private ownership of resources).

IES (based on a paper on influencing policy contributed by Peter Frost)

The Institute of Environmental Studies (IES) is part of the University of Zimbabwe and has been involved in a number of modelling initiatives. Influencing land use policy is a complex process, because while there may be a few individual 'policy makers' in government with ultimate responsibility for decisions taken and overseeing their implementation, the decisions themselves are a product of a policy formation (or decision making) process, that involves many different steps, stakeholders and interests. Influencing policy involves more than simply placing information in front of policy makers. Changes in policy are usually made incrementally, partially and involve considerable negotiation and compromise. Policy formation is likely to involve the following steps:

1. defining the nature and extent of the problem,
2. formulating possible responses (based upon technical feasibility, social acceptability and economic sustainability),
3. negotiating which response is likely to be broadly acceptable to the people concerned (this may involve lobbying, advertising and advocacy among different interest groups),
4. adopting and implementing the policy, and
5. over time, evaluating and reformulating the policy as necessary.

Clearly rigorous science needs to be involved in steps 1 and 2 but it is also clear from experience that there needs to be iterative development of responses involving participation of different stakeholders with different interests. There is not a single optimal solution. Decision tools produced independently of users are likely to fail in their objective of enhancing decision making. The possibility that FLORES can embrace participation in the development of models relevant to the comparison and evaluation of alternative policy options is, therefore, of particular interest.

Conclusions

Several conclusions emerged from the roundtable contributions of participants and the subsequent discussion. These were:

- There is a clearly articulated demand for modelling tools to assist in decision making about natural resource management at a landscape scale in Zimbabwe.
- The critical requirement is for tools to explore the long term consequences of short range decisions so that sustainability of livelihoods and environment can be taken into account.
- A number of government and non-government organisations are interested in investing in the development of capacity in modelling as part of their ongoing work programmes because they believe this will assist them in achieving their objectives.
- Spatially explicit models that allow landscape dynamics to be explored are required as are models that explicitly incorporate human dimensions.
- Influencing policy is a complex process, the key to which is achieving participation in the generation of models that allow alternative options to be explored by different stakeholder groups who then have a genuine stake in the predicted outcomes.
- Care is required in use of the term ‘policy maker’ – users or clients for models are likely to be the organisations working directly with stakeholder groups, who develop participatory models to explore the impact of different decisions on indictors that interest them in the course of their work and then use these in the process of influencing policy. The model developers, are also, therefore, the model users in the time horizon (12 months) of the present project.

It was agreed that the project activity should comprise three training / model development workshops in September, November and January involving international project staff followed by an evaluation week where participants are consulted individually in February. Informal meetings to familiarise participants with the Simile modelling environment and how FLORES models might be locally applied should be held between now and September as a precursor to the training. The first of these will be organised by CIFOR.

List of participants

Aggrey Agumya (ICRAF)
Elias Ayuk (ICRAF)
Ivan Bond (WWF)
David Cumming (WWF)
Peter Frost (IES)
Peter Gondo (SAFIRE)
Mandy Haggith (World Forests)
Misael Kokwe (IUCN)
Dominic Kwesha (Forestry Commission)
Robert Muetzelfeldt (Edinburgh)
Maxwell Mukwekwerere (Forestry Commission)
Happyson Mudavanhu (CIFOR)
Dorcas Mungwari (SAFIRE)
Ravi Prabhu (CIFOR)
Fergus Sinclair (Bangor)
Jerry Vanclay (Southern Cross)

Record of the first FLAC Workshop
19-21st September, 2000
F.L. Sinclair

This report consists of a record of the programme for the workshop, the people who attended it and then a summary of their responses to two evaluation questionnaires (one completed at the end of the first day whose primary purpose was to define a baseline and the second completed at the end of the workshop in order to obtain participants views of the workshop and the FLAC materials and process). It is followed by a short evaluation of the FLAC workshop and materials, which brings together what was learnt from the workshop process. The trainers stayed on in Zimbabwe for a further week visiting some of the participants and institutions individually.

Programme

First day

Introduction of participants

Background to this workshop (Fergus Sinclair – Evaluator)
This workshop is part of the FLORES Local Adaptation and Calibration (FLAC) project funded by DFID-FRP; the hope is that there will be one or more groups in Zimbabwe prepared to invest in the development of FLORES model(s) to assist them in their ongoing work. The goal of FLAC is to provide resources to enable groups to do this without too much outside intervention. Any such activities that do develop in Zimbabwe will help us assess how successful the FLAC package is and the usefulness of FLORES models produced using it.

Discussion and modification of the intended programme for the workshop

Simile (Robert Muetzelfeldt – Trainer)
Presentation of basic ideas and their application to different areas of resource management.

FLORES (Robert Muetzelfeldt – Trainer)
Jerry Vanclay's vision; why Simile is a good platform for implementing this vision; basic features of doing FLORES in Simile (the "skeleton model" etc).

Experiences with FLORES modelling (Fergus Sinclair – Evaluator)
Evaluation of previous experiences in developing and using a FLORES application in Indonesia - the Rantau Pandan FLORES model.

The "miombo training model" (Robert Muetzelfeldt – Trainer)
This is a minimalist FLORES model, designed specifically as a training vehicle, heavily based on the Stella miombo model that Peter Frost provided information on. This shows quite a few of the core features of a FLORES model, in a context that should have meaning to local participants.

Discussion

Lunch

The major part of the workshop was designed to get people into the concepts, language and techniques of making FLORES models in Simile. The FLAC package is top-down: starting off with using existing FLORES models in decision support, and gradually working down to more and more major adaptations of existing models, eventually to the point where people can make any arbitrary FLORES model from scratch. How far down particular people choose to go depends upon their objectives and interest. The draft FLAC manual reflects this philosophy, and the workshop took participants through key aspects in the manual, with a presentation, hands on session with the relevant tutorial in the manual and then a feedback discussion on each topic. The miombo training model was the vehicle for practicing on.

Running models
The basic techniques for loading a model, setting up displays, and running it.

Adapting models to new scenarios
Using a model in new sites, by changing data file inputs (e.g. GIS, household data)

First evaluation questionnaire

Day two

Changing parameters
Changing the values of parameters (coefficients) in equations, to calibrate the model for different situations (e.g. different tree species in a forest submodel).

Changing equations
How to edit equations to reflect different assumptions about the relationships in the model.

Lunch

Changing submodels
"Plug-and-play" swapping around of submodels, e.g. replacing one tree growth model with another.

Running submodels as stand-alone models
How to test a submodel by extracting it from a FLORES model, and running it by itself.

Making new submodels
General ideas behind making a new submodel from scratch.

Day three

Inserting a new submodel into a FLORES model
How to actually insert it; how to link up variables in the submodel with variables in the main FLORES model.

More major changes to a FLORES model
Requiring a reasonable degree of Simile proficiency; e.g. changing the structure of the model.

Lunch

Designing a FLORES model from scratch
The 'skeleton' model provides a framework for anything that we can legitimately call a "FLORES model". But how do we go about the whole process of deciding what we need in a model and how to implement it? Working through the model-design proforma in three groups with interests in developing models related to non-timber forest products, land use change and people and resources in the Mafungautsi communal area.

Discussion of the workshop and future aims

Second evaluation questionnaire

Participants (and their affiliations) - and interests

Chambwera, Muyeye(World Wildlife Fund)- linking urban economic activities to the environment
Frost, Peter (Institute of Environmental Studies, University of Zimbabwe)
Gambiza, James (Tropical Resource Ecology Programme, University of Zimbabwe) – teaching modeling to M.Sc. Ecology class
Kamumvuri, Gideon (National Herbarium & Botanic Garden) - teaching of plant conservation at the National Conservation Centre
Kwesha, Dominic (Forest Research Centre) – linking socio-economic issues with biophysical ones in a GIS and at different scales (spatial & temporal)
Mapedza, Everisto (Tropical Resource Ecology Programme, University of Zimbabwe)
Matose, Frank (CIFOR) – socio-economic aspects
Mudavanhu, Happyson (CIFOR)
Mukwekwerere, Maxwell (Forest Research Centre) – merging biophysical with socio-economic data for natural resource management
Mutinhima, Wilson (CAMPFIRE) – management of Miombo woodland projects
Ncube, Nicholas (AGRITEX)- agro-ecosystems model development, interrelationship between biophysical, climatic, and socio-economic data sets
Prabhu, Ravi (CIFOR)
Standa-Gunda, Wavell (CIFOR) – management of non-timber forest products harvesting
Tsvuura, Zivanai (Tropical Resource Ecology Programme, University of Zimbabwe) – studying population dynamics of Buffaloes in the Zambezi Valley
Zinhumwe, Cephas (SAFIRE) – indigenous woodland resources management

Resource persons (and their affiliations) – and roles
Muetzelfeldt, Robert (IERM, University of Edinburgh) – trainer
Sinclair, Fergus (SAFS, University of Wales, Bangor) – evaluator
Taylor, Jasper (IERM, University of Edinburgh) – trainer

Evaluation Questionnaire No.1 (n=15) – end of first day.

Question 1.1 What previous experience of computers do you have?

None	1
Word processing	14
Spreadsheets	12
Statistics/graphics packages	12
Modelling packages	8
Internet access	13

Question 1.2 What previous experience of modelling do you have?

None	4
Read papers describing other people's models	9
Used models created by other people	4
Been involved in design and/or implementation of models myself	4

Question 1.3 How familiar are you with the FLORES concept?

know nothing about it	1
2	5
3	4
4	3
completely understand it	1

Question 1.4 How well could you explain this FLORES model to someone else? (model diagram attached)

Nothing	0
The submodel structure	12
What the compartments and flows mean	12
What the influence links mean	12

Question 1.5 How familiar are you with the Simile modelling environment?

know nothing about it	1
2	3
3	8
4	3
completely understand it	0

Question 1.6 To what extent could you construct a simple model (with a single compartment) using Simile?

Not at all	0
I could start Simile	9
I could create a diagram	11
I could include equations in the model	7
I could run the model and produce output	10

Question 1.7 Any other comments
Overall structure is good. Need to find better balance between 'hands-on' and theory. Need to have workshop and training goals up on flipcharts for each day/session. Need to capture questions/learning on a flipchart and return to them at appropriate points during the workshop.

More practical and exercises necessary.

Going OK so far - less plenary discussions - leave that to group level - plenary for introductions and group report backs.

We need more time to construct and run simple models on areas of our interest.

Lack of a meaningful background in computers and modelling have caused such a slow pace that I am really behind. As a result I do not understand much from the demonstrations. However working on my own with assistance is paying dividends.

As someone who is starting a modelling course I need to practise more so that I would be in a position to use it professionally and also give constructive comments.

I wish such a workshop could be organised for my partners and colleagues at my workplace so that they are also exposed to this modelling tool in future.

Please continue updating the Simile reference manual. It may be difficult to contact you. Moreover, doing things and failing to is a normal learning process. But a reference manual is important for self-taught learning.

Very grateful to the organisers for taking the time and trouble to help us develop our skills and providing the appropriate tools. Ongoing collaboration would be important; that is, the issue is not just building capacity but being able to sustain that capacity, at least to the point where it is self-sustaining.

Very encouraging. Having missed part of the initial lecture and discussions I am not totally lost. The whole exercise is very interesting and relevant to my context.

Evaluation Questionnaire No. 2 (n=12) – end of workshop (day 3).

Question 2.1 Do you intend to use a FLORES approach in your work after the workshop?

Yes	12
No	0

If yes, how much time do you think you might spend working with FLORES in the next 6 months?

1	0	none
2	0	a few hours
3	3	a few days
4	6	a few weeks
5	2	regularly as a major activity in my work

Question 2.2 To what extent do you think you can continue to learn how to use a FLORES approach independently using the FLAC manual, the CD and email contact with Edinburgh?

1	0	not at all
2	0	
3	6	to some extent but may face constraints
4	4	
5	2	completely

What do you think might constrain you in developing your expertise in using FLORES?

Constraints in technical ability to work with the specifications of the model (equations etc)

Equation development and interpretation of results

The nature of information/data gathered in my work might not be compatible with FLORES

Difficulty in modelling human behaviour and institutions

Formulating and writing relationships between variables within the model. Although it is appreciated that one can go and find a 'tame' modeller to do this for one, the reality is that people with these skills may be quite rare (or difficult to access) locally.

Conditional expressions in the equation window

Lack of computer equipment

Time limitation and having lost a bit of the lessons

Time constraint is a major limitation at the moment

Interaction with local 'experts'

Question 2.3 How did you find the amount of information communicated during the workshop?

1	0	far too little
2	1	
3	4	about right
4	6	
5	1	far too much

Question 2.4 How did you find the speed at which information was communicated during the workshop?

1	0	far too slow
2	1	
3	4	about right
4	6	
5	1	far too fast

Question 2.5 What did you think about the length of the workshop?

1	1	far too short
2	6	
3	2	about right
4	2	
5	0	far too long

Question 2.6 How effectively do you think information was communicated during the workshop?

1	0	the material was very difficult to understand
2	1	
3	8	concepts were communicated satisfactorily
4	2	
5	1	concepts were communicated well

Question 2.7 What did you think about the way the workshop was structured?

(i) presentation (instruction) in plenary

1	0	far too little
2	0	
3	8	about right
4	4	
5	0	far too much

(ii) practice (working through exercises individually)

1	0	far too little
2	4	
3	5	about right
4	3	
5	0	far too much

(iii) plenary discussion

1	0	far too little
2	3	
3	2	about right
4	7	
5	0	far too much

(iv) group discussion

1	0	far too little
2	2	
3	6	about right
4	4	
5	0	far too much

Question 2.8 What did you think about the documentation (FLAC manual and CD ROM)?

(i) usability		
1	0	difficult to use
2	0	
3	7	OK
4	4	
5	1	easy to use
(ii) amount		
1	0	far too little
2	0	
3	5	about right
4	6	
5	1	far too much
(iii) content		
1	0	did not cover what was required
2	0	
3	6	OK
4	6	
5	0	covers everything required
(iv) presentation		
1	0	poor
2	1	
3	4	OK
4	6	
5	1	excellent

Question 2.9 Any other comments

Very informative. Participants should be given enough time to construct their own models and run the models using data that they would have collected prior to the start of the workshop. They can then write papers on their research.

Very excellent opportunity for biting into FLORES in practice. The course was really good for having afforded us that time. Good pace and good materials and facilitation but not enough time overall - was a bit squeezed. However up to us as users and researchers to carry on on our own.

Workshop was well presented and was very helpful for some of us being exposed to modelling for the first time. There is need to focus more on socio-economic aspects especially for social scientists.

Prolong the workshop a bit so as to have ample time for individual practice working through exercises.

Still need time to learn. Time allocated was little.

It’s a very good startup modelling workshop.

I enjoyed the discussions. However, moderator/facilitator should encourage participation from most participants rather than a few individuals.

Evaluation

The base line

At the inception workshop, a clear demand to build capacity in participatory modelling of spatially explicit resource management issues at a landscape scale had been articulated by a suite of governmental and non-governmental organizations. These organizations were well represented in the participation at this first FLAC training workshop. The organizations nominated the participants themselves and a series of informal discussion sessions had been held in Harare prior to the workshop, at which some, but not all participants, had attended and developed some familiarity with the Simile modelling environment (see minutes of the informal meetings below).

At the start of the workshop, there was a wide range of previous experience of computers and simulation modelling amongst participants and their institutions, ranging from one participant with no previous experience of computing at all to four who had implemented their own computer models. The majority had experience of using computers for word processing and/or spreadsheet operations but had not previously constructed simulation models (Q 1.1 and 1.2). Only about half of the participants had previously read papers describing other peoples models.

The effectiveness of the workshop and FLAC materials

After the first day most participants could understand the basic syntax of a model diagram and were able to develop and run a simple model (Q 1.4). The majority felt that they were now familiar with the Simile modelling environment although none felt that they completely understood its capabilities and four were clearly having some difficulty with comprehension (Q1.5).

At the end of the workshop all participants who returned completed questionnaires (80%) intended to use a FLORES approach in their work in the future (Q2.1) with the majority intending to invest several weeks or more in model development over the next six months (Q 2.2). All thought that they could continue to do this independently although half thought that they would face constraints. The main constraint identified was lack of technical ability to chose and implement appropriate relationships within their models, particularly those associated with representation of human behaviour. Other constraints included lack of time and lack of opportunities to interact with local experts.

In terms of the way in which the workshop was run, participants clearly felt that a lot of information (Q 2.3) was communicated very quickly (Q 2.4) but satisfactorily (Q2.6). There was a general perception that the workshop could have been longer (Q2.5) with less time in plenary discussion but more practice (Q. 2.7). The FLAC documentation was found to be quite daunting in its length but well presented, reasonably easy to use and to cover most of what was required in terms of content (Q 2.8). Specific suggestions for improvements were noted by the trainers during the workshop and more are anticipated over the next six months as participants use the documentation alone.

Conclusion

While the organizers had tried to ensure some previous exposure to computing, simulation modelling and the Simile modelling environment in particular, prior to the workshop, the eventual range of experience amongst participants was very broad indeed and those with no previous experience clearly struggled. It is clear, however, that people's enthusiasm for using modelling in their work was maintained during the workshop and that, even some of those starting from a very primitive knowledge of computing, developed sufficient competence in simulation modelling by the end to feel able to use such an approach in their work independently of external trainers. The major constraint that people identified to further model development was their ability to realise the sort of behaviour they wished to represent because of lack of familiarity with the technical means of representing relationships in a model. More examples and assistance in choosing appropriate ways of representing different types of relationships is required to enhance the documentation. This can be addressed in future workshops and modification of the manual, particularly with respect to representation of human behaviour. The basic form of the training and documentation was warmly endorsed by participants, indicating that the top-down approach to building competence in using and developing models was effective.

Record of the second FLAC Workshop
Nov 6th-8th 2000, Harare

Mandy Haggith, Jerry Vanclay, Happyson Mudavanhu, Peter Frost, Chipo Mlambo, Ravi Prabhu

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Summary

This document is a history of the 2nd workshop held as part of the FLAC (Flores Adaption and Calibration) project. It is a preliminary and draft record of the outcomes of the workshop. It is primarily intended as a record of the workshop process to inform those members of the project team that were unable to attend. It would be useful to produce a summarised version of this document for wider circulation and to provide a starting point for follow-up work.

We want to thank all the participants at the workshop for their hard work, enthusiasm and good humour. Thanks are also due to DfID for funding the attendance by Mandy Haggith and Jerry Vanclay at the workshop, and CIFOR for hosting it.

Achievements of the workshop

Participatory process

There is a strong sense of local ownership of the process of building a FLORES model for the Miombo woodland context, taking as a starting point the modelling of livelihood decisions of local people. The participants of the workshop were very open and participated fully and the result was a good sharing of knowledge and experience of the miombo, of decision making and of modelling.

Training in Simile

- participants learned how to use equation dialogue box and build relationships

Modelling human decisions

- demonstrated how to progress from a list of issues to constructing a model diagram
- experience in organising thoughts and applying “Occam’s razor” for parsimony

FLORES/FLAC

- developed a concept and structure for modelling strategic livelihood decisions (suitable for updating the list of priorities in Decision4).
- developed “red models” for these strategic livelihood decisions
- established the need for a crop model in ZimFLORES

Day 1

1. Introductions

2. Agenda

The main agenda of the meeting was outlined which was to model human decision making. The people attending the workshop were from different backgrounds, different professions and different institutions and thus had special interests in attending the workshop. Most wanted to know more about modeling human decision making so that they would apply such knowledge in their fields of work.

All the workshop participants agreed that the way forward in this workshop was to write models with specifications on human decision-making. It was highlighted that it would be difficult to work with complex models therefore a need to specify key decisions to work with. It was also important to look at the implications of specifying the model. There was also need to take note of temporary changes taking place and the relationship between human decision-making and its interaction with the environment.

3. Recap previous workshop outcomes
Peter Frost: previous workshop drew heavily from the previous STELLA model, and the biophysical parts of FLORES. This was a useful entry point to simile and FLORES. But the Miombo is driven by the decisions people are taking. These weren't really explained, but they are the guts of the issue. The Rantau Pandan model created a huge basket of specifications which is extremely complex and intractable to model. We want in Zim to avoid getting into a long list of specifications and take a more cut down view, and work on what are the key decisions. We must focus on the decisions and decision-making. How might we come up with a reasonable list of decisions. Please lets write good focussed specifications. We should think of a pro-forma of writing decision specifications – he has an example.
Ravi Prabhu: 2nd decision-making meeting. They have looked at the decisions made by local government/district level. Hope to move beyond just specifications and also look at how it can begin to be modelled in simile. Should we use boolean logic. We want to look within the equations. Perhaps this can continue with sessions after the workshop.
Jerry Vanclay: Tom Evans (SCIPEC) has studied over 70 models of this kind and he comcluded that FLORES is unique in trying to look at both bio-phys and socio-economics and temporal and spatial things all together.

4. Aims

THE WAY FORWARD

The participants made their contributions as to what they would like to achieve by the end of the workshop. These are as follows:

- To come up with a clear plan of the steps needed to build a model specifically for the Zimbabwean forests
- Come up with a simple decision-making framework
- A way as to how human decisions can be modeled
- Simple household decision-making model
- Simple conceptual household model described
- Develop a model driven by the human factor
- How to model human decision making
- Model the various decisions that households make
- Develop specifications for decision-making for local contexts
- How to incorporate non-quantitative decisions in a model
- A better understanding of how to represent decision-making
- Model out the effects of the decision to commercialise natural resources
- Model important decisions made in wildlife management
- Tackle issues of scaling up household village – district level decisions
- To disseminate models into practical work and teach others
- Come up with questions and requests for the Edinburgh SIMILE team

DISCUSSION
Mandy Haggith stressed that it was important to localize the model as much as possible and to make it easy to comprehend by the local people. This was interjected by Peter Frost who stated that this will only be possible if we get the tools and the training to build the model locally.

It was indicated that there is a chain of decisions and that there is need to relate these decisions one way or the other. If possible there was need to relate the decisions to expectations from the model or what the participants wanted to achieve. It was important to look back at the decisions from the first workshop and their importance.

5. Recap of decision-making sessions
Prioritising the household decisions
District level decision making groups
District level decisions
Chains of decisions
Constraints on decisions from other levels and other agents
The case studies we choose must substantially effect the results we want from the model

6. Presentation by Jerry and Mandy of some SIMILE models

7. Case Studies

It was suggested that the participants form two groups to discuss three options i.e.

1. communal lands (10)
2. CAMPFIRE (0)
3. State forest (5)

It was suggested by Peter Frost that there was a need to focus on a single type of decision to start with. Ravi Prabhu suggested that the participants might consider crop production as the major decision. Peter suggested that the groups might consider discussing their options along either of the following lines:

1. Labour allocation decisions between the amount allocated to forest related activities versus non-forest.
2. Time allocation decisions on marketing versus non-marketing activities

Small group analysis of case study decisions

Group 1: State Forest (Household decision-making)

The main issue taken into account was the time/labour allocation for the extraction and processing of forest products. The key variables for time availability that were taken into consideration were some alternative activities that can be done. The time and labour allocated to forest products was taken as a residue of the time and labour allocated to these alternatives.

Key Variables for time availability – alternative activities

- Crop production
- Gardening
- Animal husbandry
- Marketing
- Domestic chores
- Leisure
- Eating and sleeping
- Health and reproduction
- Off-farm activities/alternatives
- Human capital improvement

It was indicated that there are some internal and external driving forces behind these activities. The internal forces were taken to be those at the household level and the external ones were considered to be higher level driving forces.

Internal driving forces/motivation

- Cash needs
- Subsistence
- Shelter
- Leisure
- Culture/identity
- ➢ Transaction cost
- ➢ Opportunity cost
- ➢ Return on labour/time
- ➢ Access to technology/implements

Higher level driving force

- Market prices
- By-laws & regulations and norms
- Resource quality and conditions
- Incentives
- Season/climatic conditions
- Information

Information drivers

- Past experience
- Anticipated gains in future
- Current conditions and constraints
- Other households
- Innovation
- Learning

This labour and time allocation involves answering the following questions:
WHO?

- Age differentiation
- Class/status differentiation
- Gender differentiation
- Skill differentiation
- Ethnic differentiation
- Wealth

WHERE?

- Resource quality and conditions
- Location (of household and resource)
- Access rights/ownership
- Distance
- Availability of resource

WHAT?

- Firewood
- Mushroom
- Thatch grass and broom grass
- Poles
- Honey
- Reeds fruits

Responses
Q. Is the market a major issue in state owned forests?
A. It depends on the readiness of the marketing e.g. market for poaching products

Q. How do the variables/issues combine to form one major decision?
A. Took time allocation for forest products as a residual to time allocated to other activities.
Q. What would be the criteria under which decisions are made?
A. Needs and Goal-based models e.g. companies mainly base their decisions on goals.

Group 2: communal lands

Household Crop Production Activities: key decisions and criteria

What to produce?

- Types of crop needed/preferred
- Family needs/preferences for food
- Types of inputs needed

How much to produce?

- Available land area
- Status of household food stores
- Family size
- Availability of draught power
- Level of remittances
- Amount of inputs needed
- Availability of credit
- Scale of production (subsistence vs commercial)
- Accessibility of markets

Where to produce it?

- Land quality
- Land tenure
- Location of land (distance to homestead, water, wilderness)

When to produce it?

- Timing of rains
- Production calendar
- Availability of draught power
- Crop requirements
- Need for money
- Neighbours' decisions
- Traditions

How to produce it?

- Availability of draught power (source, cost)
- Availability of implements (source, cost)
- Availability of seeds (source, cost)
- Availability of inputs (source, cost)
- Availability of credit (source, cost)
- Availability of labour (source, cost)
- Crop requirements
- Crop management practices

Produced by whom?

- Gender perceptions
- Household division of labour
- Labour availability
- Source of labour (household, hired)

Introgenic and exogenic factors affecting decision-making

- Weather
- Historical factors
- Information
- Primary needs
- Secondary needs
- Market prices ansd availability
- Culture

A similar analysis can be carried out for marketing of produce, considering the questions of what, how much, where, when, how, by whom, and to whom.

Note: there is a sequence to these decisions. Earlier decisions (in time) will tend to constrain the options available for later decisions.

Need to structure these decisions (with others) into some form of decision tree.

Need to clarify the distinction between options (alternative decisions) and the criteria under which these decisions would be evaluated.

	Criteria					
Options	C1	C2	C3	C4	C5	C6
1						
2						
3						

Proposal that a specification pro forma could be developed for specifying decisions. Peter Frost and Mandy Haggith worked together (Peter produced the initial ideas, Mandy made some adjustments) to produce a set of 'trigger questions' for specifying decisions. (Attached as an appendix).

At the end of day one the participants tried to give values to some of the variables suggested for household decision-making. These are shown in the table below:

VARIABLE	VALUE
Land area	2.5-3.3 ha
Home garden	0.3ha/HH
Family size	6
Food requirement	24-30bags*(50kg)
Livestock holding capacity	5 cows, 4 goats, 3 donkeys
Remittances of maize to town	
Cash requirement	$250- $80 000
Firewood consumption	4 tonnes/year
Milk production & consumption	200litres/cow/year
Meat consumption	45kg/year
Non-timber forest products	
Maize production	862kg/ha/year
Food deficit	

Day 2

Started with the continuation of group work. The main ideas were to:

- constrain the number of activities to be considered
- build a simple model of animal husbandry, crop production and forest
- evaluating the alternative activities

There was need to consider the timeframe and frequency the decisions are made.

Group 1

Some more questions to be looked into:

- How much: is produced? Inputs?
- To whom? Would they be marketed? A look at the distribution.
- How? Technique, method, technology
- Criteria and weights

Case of a Shangwe household

What: Maize/cotton, thatch, cattle

Who:: 6 adults, 9 children
:

Age differentiation	Gender differentiation	
	male	Female
Adults	3	3
children	4	5

	Item	Quantity	Price
Produce:	Maize	600kg/ha	$5/kg
	Cotton	5-6 bales (220kg/ha)	$13/kg
	Cattle	8 beast = 2 draft, 2 cows, 4 young	$600/beast
	Thatch	30 bundles	$4/kg

Inputs:	Land for maize	2ha
	Cotton	4ha
	Labour for maize	1.5 person years/ha
	Cotton	2.0 person years/ha
	Thatch	0.25 person years/ha
	Cattle	1.0 person years/ha
	Other	5.25 person years/ha

Consumption:	Maize	600kg
	Milk	200litres
	Meat	67kg
	Thatch	10 bundles
	Cash	$10 000
	Other	-

Net cash = 600(5) + 13(220)(5) + 0.25(6000) + 20(4) = 18880

Time lines were also drawn for activities –
Maize between November and April
Cotton grown between October and July
Thatch grass cut between August and September
Cattle herded all year round.

Things to consider doing next

1. What happens if we double/allocate none at all?
2. Linkage model/weighting
3. Benefits distribution scenarios within the household
4. synthesize all for our model

Group 2

Three decision-making areas: crops, livestock and non-timber forest products

Crops

- Primary decision if land is available is to grow maize
- Food security central
- Always grow for subsistence needs
- Resources shared at non-market prices
- If additional land is available grow crops such as cotton and groundnuts etc.
- Cultivate land until returns are marginal
- Inputs: inorganic fertiliser
- Output prices
- Home garden – vegetables (subsistence & cash)

Livestock

- Deficit of draft power on communal lands
- Cattle – status investment
- Boom and bust (drought)
- Buy cattle whenever cash reserves are sufficient
- Need to herd cattle
- Sell livestock for school fees

Non-timber forest products

- Surplus labour
- Jointly done and other activities
- Wealth status (for some NTFPs)
- Market availability
- Seasonality
- More livestock = more maize, draft power, meat etc.

Group 3

The third group tried a variety of approaches, and produced an analysis of what factors influence the decision to invest time and effort in crop production, animal husbandry and forest product collection. The results are in Appendix 2, ranked during the afternoon.

Prioritization of model components

The results of the third groups activity became the starting point of a plenary exercise, to rank and prioritize the factors which needed to be built into an initial miombo FLORES model. The result is in Appendix 2.

Day 3

Linking model components

The results of the ranking activity at the end of Day 2 were condensed into 8 vital model components (Food, Money, Land, Labour, Social Capital, Maize, CashCrop, Livestock, NTFPs). Two small groups were given the exercise of drawing connections/links between these components. The results have led to the two ‘red models’ : red_decisions1.sml and red_decisions2.sml.

After coffee participants continued this work around the computers.
There was a short training session on boolean logic and how to write conditional statements.

PM:
More instruction by Jerry on influences/flows/and relations.

Remaining time was spent on evaluation and looking forward, with all participants using cards to express their opinions. The results of all these brainstorms are next.

Training needs

I need to know how to come up with the equations that enable the model to be run , especially for decision making
Writing the mathematical functions
Working with equations
Writing decision equations
Tutorials (simple on decision making)
Writing questions and use of different operators in SIMILE
Developing equations (meaningful)
In-depth training on boolean operators
Training on modelling logic
Understanding of SIMILE equations
Formulating equations for modelling decision making
Tutorial on decision-making
Examples of a compelte decision-making model
Implications of using different approaches to model decisions
A more detailed and efficient SIMILE

What’s next?

Decision making ahoy
Red models for various sites
Develop new bio-physical submodels if necessary
Calibrate biophysical sub-models
Develop a decision-makiing model that can be run
Follow-up on specific models developed by group or individuals
Develop red model for decisions
Simple red models
Validate with field data
Develop a simple model based on field data
Develop a simple model of decision making
Developing local model conceptually and running it
Bouncing off conceptual model with villages
Have a trial model to work on

Evaluation of the workshop

Best things about the workshop

The beginning – that is when I thought we had the clearest sense of direction
The group sessions that charted decisions

Now capable of making red models
The discussing mood
Splitting into groups for focussed thought and discussion
Participation and involvement was very good with a lot of time spent on group work
Decision model Day 3
Intro to equations
Great atmosphere
Participatory learning
Hands-on exploring Simile
I at least know a few things about simile and the flores modelling techniques
Free discussion
Exposure to making specification about decision-making
The red diagram and its source

Worst things about the workshop

Actual modelling process
Limited time for hands on activities
The inablity to 'figure'/'number' red diagram
Loss of sense of direction at times
Failure to send the decision-making tutorial/sample models beforehand
Direction of activities was often decided ad hoc
Not enough time on theory of how to model decisions
Discovering that I need to learn more about decision-making
Unfocussed, concentrating on one task for only a short time before switching to something completely different
Needed more practice on the computer
Not being too clear about workshop direction/output
Not much training

Concrete objective for the next workshop

Development of a simple skeletal model
Working complete model
Running a miombo model in simile
How to develop equations, and 'test' and review red models
Sensitivity analysis of model to highlight important components of models for further study
Learn how to make equations on decisions
Have some dataset for use in making equations
To learn how to write equations in decision modelling
Develop a concrete model basedon a real situation
More depth about simjile, decision-making, equations and running it
Develop a framework for identifying, structuring and understanding key human decisions affecting landuse in Miombo

Duration of the next workshop

Same for workshop as now, more time for tutorials
3-4 days
More time, but with more concrete objective and outputs
5 short days
5 short days away from town
One week in an isolated venue
1 week
One week for next workshop
Longer – say 7 days
Minimum 5 days, maximum 10 days
10 days or 5 days excluding training
20 days

Messages for Edinburgh & Bangor

SIMILE requests

1. Removal of features people liked – please bring them back!

- Model properties is no longer a menu item
- Equations window : Available functions box. Some core functions, such as time(N), if..then..else are not in this functions box. ‘pi’ is no longer there.
- Drawing a graph using the sketch graph function does not produce ‘graph(_)’ in the equations window, and even after graph(Var) is written there, several error messages are generated and the submodel properties window is thrown up.
- Hide detail’ does not appear to be working (can’t hide influence arrows)
- Add ^ (power function) to keypad
- Add “mouse-over” help to keypad, especially for ; (or), , (and), ^ (power) and = (equals ==)

2. Please can simile default to the pointer

3. Navigation aids

- A ‘find’ facility is essential for working with big models. Find variable by name. Find all booleans. Find submodels.
- Find all 11-element arrays, etc, etc.
- We need a way of knowing what equations a variable is used in, what is on the right hand side of an influence arrow, what is influenced by a variable… eg: the equation box for a variable needs an extra column showing ‘links to’ as well as ‘links from’. It would be good to be able to light up the chain of influence from a variable downstream.

4. Is it possible for the ‘unit’ for variables with number values to be ‘numeral’ instead of ‘1’?

5. Proposals for new features:

- ‘Decision Variables’: Suggestion that these might be a new kind of variable (special case of current variables), with a new icon. They are conclusions of decisions, so their equation must be a conditional statement. We need to devise support to help the user ensure that they construct boolean conditions from the input variables… ie: a basic rule editor.
- ‘Spatial Variables’: Would it be possible to support/semi-automate the addition of spatial variables (x and y in a grid arrangement, for example)?
- ‘Related objects’: Can some syntactic sugar be provided for things like ‘my village’ ‘my patches’ ‘patch1’, ‘patch6’, ‘other households’, ‘all the other households in this villlage’ etc?

6. Incomprehension issues:

- People find the error messages difficult to understand.
- The pop-up descriptions of available functions in the equation window is appreciated, but clearer wording is wanted (eg: ‘makearray ; Makes an array of the given number of values from the first argument’ isn’t very clear)
- A complete, very clear, set of explanations of these functions, with examples for all of them, is a top priority requirement.
- There’s a need for a user friendly ‘Guide to writing equations in SIMILE’.

7. How do we print from SIMILE? The print function in the file menu doesn’t work.

8. The skull for the delete tool is too big to be able to accurately delete the right object – it needs a pointy bit.

9. Keyboard shortcuts? Eg: control-z for undo (undo is no longer on the tool bar)

10. It would be good to be able to change the dimensions of an array, and then for the influence arrows to light up to show dimension conflicts.

11. Attribution. It should be possible (necessary?) to give an attribution for each equation. Unattributed equations should be distinguishable in colour from attributed ones. This might reflect something between red (no equation) and black (stable and well justified equation), like purple (‘draft’ equation).

Training needs

A number of training needs were identified – see the brainstorm results above. The key need is for training on the equation language, with particular emphasis needed on how to write rules in SIMILE. There seems to be a ‘shock factor’ when moving from the user friendly diagram to the rather intimidating equation window.
Other particular training topics needing more support : Handling arrays and lists; Time; Populations; Relation submodels

Other messages for Bangor and Edinburgh

There is a strong desire for local ownership of the process, and for the process to continue beyond March. If the process stops at the end of March, then the local capacity that has developed will be lost. It is vital that FRP understand this. There is a strong wish for a continuation of the modelling work for a further 12-18 months, with funding directly to Zimbabwe so that they can manage the process more effectively, combining it with other locally-oriented research work, with communities and in the field. The local team want to write a strong local-demand-driven proposal for funding for such a continuation.

FRP need to be told of the achievements that have been made already. They should be told now that this process is very exciting, for knowledge sharing and for building capacity among the next generation of researchers and policy makers in using computer-based analytical tools. The current situation is unique, with a significant number of people devoting considerable time for no pay.

Fergus, please start to put together the report on FLAC for FRP now, and begin work on evaluation now, so that the Zim team can input strongly into this.

We need to put effort into considering how the Zimbabwe experience can be passed onto other areas.

Some more attention needs to be paid to packaging FLAC to make it more accessible – for example, a FLAC FAQ, a usable (non-tutorial based) user manual. People need to be enabled to arrive at FLAC from various places (not all non-modellers, for example) and get their hands onto the software directly, in addition to the systems-dynamics modelling tutorials. There is a stong affirmation of the model and submodel library concept, which needs to continue to grow to enable users to ask more and deeper research questions through their modelling work.

It would be good to develop and package the 'red models' concept – the methodology.

Local participants are asked to bring to the next tea-and-simile session (December), 1 page on 'What is my interest for the longer term development of models?'

There was great disappointment that Jasper wasn't at this workshop. It is important that he is at the next one. In the longer term we need to think of ways to disseminate Jasper's knowledge – perhaps by apprenticeships?

The next workshop should have two phases, first a training phase, second a model building phase with a smaller subgroup of people who'll commit to getting it working. For the next workshop it is important that participants get preparation materials, such as example models, beforehand.

Request that the March meeting is not just about wrapping-up FLAC, but also an opportunity for the team to do a further step in the process. Ravi will try to enable a follow-on workshop sometime beyond March.

It would be great to have a two-page summary from Robert and Jasper of where they see SIMILE going into the future (next two years…)

Communication issues :
We must think about paper outputs of the FLORES process.
Rantau Pandan paper.
A newsletter item on the Zimbabwe process.
A deeper conceptual paper on the FLOREZ process.

Thanks for the WWW-sites in Edinburgh. Please also note www.virtualteam.f2s.com/methods. Ravi would like to link there to FLORES work. Good WWW-presence is important. Please can we all keep each other informed about WWW-site developments, URLs etc. Please let's also use the FLORES email list to keep each other better informed about progress.

Appendix 1: Trigger questions for specifying decisions

Peter Frost and Mandy Haggith

- What is the decision?
- Who is directly involved in making the decision?
- How frequently is the decision made (daily, weekly, monthly, yearly)?
- What are the options?
- For each option, what conditions are necessary (requirements)?
- For each option, what conditions make it impossible (constraints)?
- Does the decision involve choosing a single option, or balancing multiple options?
- If single, how is the best option chosen?
- If multiple, how many can be chosen, and how is the balance achieved?
- What criteria are used to evaluate the options?
- How are the criteria evaluated? How are the options compared?
- What are the effects of the decision?
  - Actions? Where?
  - Change in quantities?
  - Processes?
  - Events?
- Who and what is affected by the decision and how?
- Linkages: to what other decision(s) is(are) this decision linked?

Appendix 2: Ranked decision factors (Thanks to Peter Frost for this record)

What factors determine the investment of time and effort in different production activities?

- **Crop production**

⇒ *Need for food for household food security* (a function of household size; level of household food stores; commitments to dependants) = 12, 2, 0, 0, 0 (68)
⇒ *Household needs for cash* = 2, 8, 0, 1, 0 (44)
⇒ Access to markets = 0, 0, 0, 0, 0
⇒ Anticipated price for products = 0, 0, 1 ,0, 0 (3)
⇒ Time of year (season) = 0, 0, 0, 1, 0 (2)
⇒ *Amount of land available* = 0, 2, 3, 1, 0 (19)
⇒ Quality of land available = 0, 0, 0, 0, 0 (0)
⇒ *Crop type(s) (grain crops, vegetables, cash crops)* = 0, 0, 2, 3, 7 (19)
⇒ Crop management requirements (weeding, pest control, fertilizer) = 0, 0, 0, 0, 3 (3)
⇒ *Availability of draught power* (own, borrowed, hired) = 0, 2, 4, 3, 0 (26)
⇒ *Availability of inputs* (distance to market; price; access to cash or credit) = 0, 0, 3, 5, 1 (20)
⇒ Storage life of food products (pests, post-harvest losses) = 0, 0, 0, 0, 0 (0)
⇒ Information (prices, crop management practices) = 0, 0, 0, 0, 0 (0)

- **Livestock husbandry**
  - ⇒ *Number and mix of livestock* = 7, 0, 1, 0 (30)
  - ⇒ *Need for livestock in crop production* (draught power, manure) = 5, 9, 1, 0 (49)
  - ⇒ Household need for livestock products (milk, meat, hides) = 0, 1, 5, 1 (14)
  - ⇒ Labour available for herding (season, herd size) = 1, 0, 1, 6 (12)
  - ⇒ Animal husbandry requirements (dipping etc.) = 0, 0, 0, 0 (0)
  - ⇒ *Potential for cash sales* (markets, prices) = 0, 1, 4, 4 (15)
  - ⇒ *Social capital* (measure of wealth and status, bride-wealth) = 2, 3, 4, 3 (28)
  - ⇒ Availability of fodder (grazing land, grazing in fields, stover) = 0, 0, 0, 0 (0)
  - ⇒ Information (animal husbandry practices, market opportunities) = 0, 0, 0, 1 (1)

- **Gathering of NTFPs**

⇒ *Availability of labour and time* (gender and age-related roles) = 1, 6, 6 (21)
⇒ *Household needs for NTFPs* (e.g fuelwood) = 13, 2, 0 (43)
⇒ *Household needs for cash* = 0, 4, 5 (13)
⇒ Access to markets (distance, price, information) = 1, 1, 3 (8)
⇒ Time (seasonality of products, availability of labour) = 0, 0, 1 (1)
⇒ Accessibility of products = 0, 0, 0 (0)
⇒ Durability/longevity of products = 0, 0, 1 (1)
⇒ Cultural features (norms, taboos) = 0, 0, 0 (0)

Tasks

1. Identify the links (connections, relationships) between the exogenous and endogenous drivers and the determinants of the decisions, as well as specifying the nature of the link (shape of the relationship)
2. Produce specifications for each of the three decisions using the information summarised in 1. Above

Appendix 3

Participants of the 2nd FLAC Workshop on Modelling Decision–Making

6-8 November 2000

Ayuk, Elias	ICRAF	eayuk@mweb.co.zw
Chambwera, Muyeye	WWF	mchambwera@wwf.org.zw
Frost, Peter	IES	pfrost@science.uz.ac.zw
Gambiza, James	TREP	gambiza@trep.co.zw
Gondo, Peter	SAFIRE	peter@safire.co.zw
Haggith, Mandy	worldforests	hag@worldforests.org
Kamumvuri, Gideon	NH& BG	srgh@icon.co.zw
Kowero, Godwin	CIFOR	g.kowero@cgiar.org
Mandota, Simba	SAFIRE	simba@safire.co.zw
Mapedza, Everisto	CASS	mapedza@trep.co.zw
Matose, Frank	CIFOR	f.matose@cgiar.org
Mlambo, Chipo	CIFOR	chipom@netscape.net
Mudavanhu, Happyson	CIFOR	mudavanhu@consultant.com
Mukwekwerere, Maxwell	FRC	
Mungwari, Dorcas	SAFIRE	
Nyirenda, Richard	CIFOR	r.nyirenda@cgiar.org
Prabhu, Ravi	CIFOR	r.prabhu@cgiar.org
Sibanda, Manasa	SAFIRE	manasa@safire.co.zw
Standa- Gunda, Wavell	CIFOR	wgunda@wwf.org.zw
Tsvuura, Zivanai	TREP	tsvuura@trep.co.zw
Vanclay, Jerry	SCU	jvanclay@scu.edu.au

Specification of the Mafungautsi FLORES model
First draft November 2000
The ACM team based in Zimbabwe

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1. Introduction – 'vision'

1.1 Purpose and audience

This document is a discussion paper in support of the FLORES modelling work underway in Zimbabwe. It is aimed primarily at researchers in the ACM programme, particularly in Zimbabwe.

Many people have already contributed time and energy to the process of working towards a FLORES model of people in the Miombo woodlands. The result is a considerable amount of knowledge, information, ideas and analysis. The purpose of this document is to try to pull this thinking into one place and to give it some structure, in order to clarify the scope of the model, to identify information and knowledge gaps, and to help plan how to build, test, refine and use the FLORES model. Please read it critically. It should contain all of the issues that you consider critical in your research. It should not emphasise things that you think are of minor importance.

The purpose of the Mafungautsi FLORES model is to simulate the impact on local people's livelihoods and on the forest resources, of processes of communication, collaboration and social learning in response to changes in resource access regulations and other policy interventions. The process of development of the Mafungautsi FLORES model will be by a series of learning cycles to scope, conceptualise, build and test the model.

This document first gives some background and states the model assumptions, then in section 2 the model is summarised. Section 3 deals with the scope of the model, and the tenure framework for people's access to resources. Section 4 specifies how people are represented in the model. Section 5 covers the biophysical resources. Section 6 concludes by explaining how we intend to build, test and improve the model.

1.2 Background

FLORES history

Three years ago, Jerry Vanclay at CIFOR initiated an ongoing modelling process with the goal of creating a generic model of land use change at the forest frontier, to be called the Forest Land Oriented Resource Envisioning System: FLORES [Vanclay 97, Vanclay 98]. The ensuing process has been a collaborative effort to share knowledge between people from many disciplines, from anthropology to zoology, concerned with forest resources and the people dependent upon them.

The FLORES modelling process has involved a mixture of intensive workshops and individual research work to define specifications, gather and process GIS data, implement models and even develop new modelling concepts. Sometimes, when the models we produced reached extreme levels of complexity, it seemed as if we were Fiddling Loads Of Ridiculous Equations Simultaneously. At other times, there have been serious efforts to pull the ideas together into more coherent model structures, and to Find Lots Of Really Enlightening Simplifications. The result has been a number of models, including a comprehensive model callibrated for the Rantau Pandan area in Sumatra, Indonesia.

In April 2000, a workshop in Gwai, Zimbabwe initiated a new phase in FLORES modelling. A FLORES model is now being developed for the Miombo woodlands in order to test the genericity of some of the FLORES model structure and concepts, to develop a transferable methodology for FLORES modelling processes, and to build modelling capacity in Zimbabwe.

FLAC: FLORES Adaptation and Calibration package

The FLAC project, led by the University of Bangor with the University of Edinburgh, is aimed at developing support materials for FLORES modelling processes, including a framework FLORES model which can be readily adapted to new contexts, plus a library of appropriate submodels which can be plugged into the framework model. It also involves improvements in the user friendliness and flexibility of SIMILE, the modelling environment which the FLORES process has mostly used so far, and user support and training materials for SIMILE and FLORES. The FLAC package is being trialled in Zimbabwe in support of the Miombo FLORES modelling work. FLAC, like most of the FLORES work so far, is funded by DfID.

ACM

'Local People, Devolution and Adaptive Collaborative Management (ACM) of Forests' is a project, led by CIFOR, seeking to understand how human well being and forest resource quality are impacted by processes of collective action, communication and learning, and collaboration and conflict between forest stakeholders. The project is using participatory action research methods, and is seeking to develop novel research and social learning tools, including simulation models.

The ACM project team in Zimbabwe has taken the lead role in the development of the Miombo FLORES. Their research sites around the Mafungautsi state forest in Gokwe district of Zimbabwe will be used as a knowledge base for conceptualising the model, and as sources of data for callibrating and testing it. The ACM project will also provide opportunities for other spin-off mini-modelling exercises to explore related ideas such as collaboration. Some of the ACM project's collaborators in Zimbabwe may also produce related FLORES models for other research sites or forest contexts.

An over-riding aim of the FLORES modelling work is to discover insightful ways of simplifying the large heaps of relevant information, without limiting the scope of the model such that it becomes irrelevant to policy makers or implausible to researchers as a representation of the situation on the ground. This requires a delicate balancing of expressiveness (*ie:* ensuring meaningful representation of the key concepts) and tractability (*ie:* ensuring a model that can be implemented, and run with reasonably modest computing power). Previous versions of FLORES have not yet achieved this balance effectively. They have either been runnable whilst trivialising important concepts (particularly social concepts such as resource tenure and collective activity); or richly expressive but too complex to fully implement. The challenge for us is to find a middle way.

1.3 Assumptions

This section is an honest effort to spell out what we are missing out, simplifying away and generalising.

- This document assumes that the Mafungautsi research sites will be the context for the model.
- The landscape is modelled as patches of land containing models of the biophysical resources.
- Human society is modelled as households within villages.
- Access by human agents to the resources in the land patches is defined by tenure relations, which are dynamic over time.
- The humans cause impacts on the biophysical patches by *actions*, which are driven by their *perceptions* of plot conditions and their strategy. The primary feedback from the biophysical model to the human submodel, is in the form of *yields* of field and forest products, in response to the human activities.
- The smallest decision-making unit is the household.
- Decision making within households can be modelled effectively at two levels: strategic decisions being taken annually and labour allocation decisions monthly.
- Strategic decision making can be modelled by assessing a set of livelihood options in the light of household needs and resources, resulting in a priority ordering of the options.
- The strategic resources available to a household are land, livestock, labour, dosh (see below) and social capital, which are interchangeable.
- Monthly labour allocation can be modelled by sharing available labour across a set of activities according to the priority ordering which resulted from the strategic decision.
- The value of forest products, crops, money and other consumable resources can be measured using a generic economic unit, the 'dosh', (daily ordinary subsistence per household) as a common currency.
- Marketing of resources is modelled as a simple conversion of yields to the common currency.
- Debt and credit are not subject to limits.
- Off-farm employment is only achievable by emigration.

2. Model Overview – 'sketch'

2.1 Model structure and dynamics

Figure 1 shows the framework structure of the FLORES model. The model diagram shows on the left hand side, the human aspects of the model, and on the right hand side the biophysical aspects in patches of land. Between these is the tenure model.

The model dynamics involves three rhythms.
1. Most of the human aspects of the model, including policy lever interventions, are considered strategic and are modelled with an annual time step.
2. Interaction with the biophysical submodel is by monthly activity decisions (driven by household strategy and perceptions which pick up seasonal variations). The whole of the biophysical model runs with a monthly time step and yields are generated monthly.
3.The movement of fire across the landscape is handled in the fire submodel which runs occasionally with a time step of just a few hours.

2.2 Social aspects

The model covers one Resource Management Committee (RMC). There are several villages in the model, each led by a Sabukhu. Within each village, there is a population of households. New households can be formed by marriages, and immigration and households disband if everyone leaves or dies. Within each household there are the following submodels:

- *People:* this represents the demography and health of the household, ie: children, women, men, and elders.
- *Strategic decisions:* annually the household assesses their needs (for subsistence and aspirations for consumption over subsistence levels) and their resources (land, labour, livestock, economic resources (dosh) and social capital) and chooses their livelihood strategy. The strategy is defined as a set of prioritised options: subsistence cropping (maize), cash cropping (cotton), animal husbandry, NTFP collection and wood collection.
- *Livestock:* this represents the household's cattle and their donkeys, including decisions to purchase, sell and slaughter them in addition to their natural reproduction and mortality.
- *Economics:* this represents the household's economic resources, investment and spending decisions, and income (from monthly yields).
- *Activity decisions:* monthly the household decides how much labour to allocate to which activities on which patches, based on their perceptions of their patches (ie: the patches to which their tenure relations give them access) and their strategy.
- *Yields:* monthly the response to their activities is a set of yields, which are converted to dosh, consumed to meet the household needs, and any surplus is stored for strategic use in the economics model.

2.3 Biophysical aspects

The biophysical model covers the fields, gardens, vleis, and forest around the villages. It includes:

- Agricultural aspects, including crop models for maize, cotton and garden crops, a grass model involving the grazing behaviour of livestock, and beehives.
- Forest aspects, including a forest model, termites, trees, harvest of poles and firewood, NTFPs.
- Other biophysical aspects including fire, rainfall, and wildlife.

2.4 Connections

The social components of the model have access to the biophysical resources via tenure relations, and resource access regulations. The tenure arrangements include individual holdings of gardens and arable land, village common grazing and woodland, and state forest land. Resource access regulations include RMC controlled permit systems for some forest resources, and Forest Protection Unit enforced rules limiting access to others. The rules can vary in their enforcement level, and sanctions may be applied.

The model has a small set of exogenous variables or model drivers, which represent climatic externalities like rainfall, and policy levers such as product prices.

3. ‘The big picture’

The purpose of this section is to define the boundary and scope of the model, and the linkages between the social and biophysical components.

3.1 Spatial representation of the landscape

The model should cover an RMC, including several, perhaps 3, villages, in order to model the overlaps in their resource use, plus their associated lands, plus an area of forest extending to at least a 10km radius (a little greater to allow for some forest land to be beyond the usual reach of village impact). Some questions regarding scope still remain to be answered.

- What should be the spatial scale, and granularity, of the model?
- What area of communal land? What area of forest?
- How many patches, and what size? (minimum 0.25 hectare)
- What GIS data layers are needed?

3.2 Tenure of land and other resources

The FLORES model connects patches of land and biophysical resources to the social part of the model by tenure relations, so a rich description of tenure is needed to specify this part of the model
Land tenure categories:
state forest, common grazings, common forest land, individual holdings.

CPR arrangements and other resource rights
Resource access arrangements are highly variable ([Campbell *et al* 00], [Campbell *et al* 96], [Mukamuri *et al*]) . There are different access rights for different resources. Regulations are set by the RMC and by the FPU (Forest Protection Unit of the FC). The enforcement of regulations varies for different resources. Enforcement varies over time, and can be influenced by extreme weather events (*eg:* during droughts, hunting may be tolerated) and other factors (*eg:* after a bumper harvest, when poles are needed for granaries, pole cutting may be tolerated).

Access to resources (*eg:* by permits) is not the same for all people. Social capital is important in getting access to permits for finite resources. For example, some Shangwe households make a significant part of their livelihood from thatch grass and will get disproportionate access to RMC permits when they are issued in early May (most people are busy with maize harvest at that time). Some people are FPU informants and are virtually immune from sanctions from breaking regulations.

Some examples of resource access regulations and enforcement status:
Hunting: forbidden and strictly enforced by FPU.
Pole cutting: forbidden and moderately enforced by FPU.
Fibre collection: forbidden and moderately enforced by FPU.
Wild honey collection: forbidden and moderately enforced by FPU.
Grass collection: controlled by RMC and strictly enforced.
Firewood: RMC sets official days when firewood can be collected. Not enforced.
Forest fruit picking: (by women, often in groups, a big nutritional issue Oct-Dec) controlled by RMC, not enforced.
Wild fruit picking: for consumption, not for selling. Enforced by households.
Domestic fruit picking: restricted to individual household. Strictly enforced by household.
Fruit tree felling: forbidden. Strictly enforced by chiefs (sabukhus).
Grazing in forest: not controlled by FC
Grazing on vleis: limited to early wet season, restricted (to protect thatch grass) later. Enforced by Sabukhus (or RMC)
Grazing on common land: Forbidden in wet season. Allowed in dry season. Strictly enforced by Sabukhu.
Grazing on fields: Must be open for grazing in dry season, closed in wet. Enforced by households (wet) and Sabukhu (dry).

*We need to know more about the institutional arrangements for communal forest lands.

Inheritance issues and definition of how resources can change hands
All land belongs to men and the formal pattern of inheritance is primogeniture, though, de facto, land is subdivided between brothers in some cases. Emigrants' land is reassigned by the Sabukhu. Immigrant men may be assigned land by the Sabukhu
*under what conditions?

Rental arrangements.
There also appears to be significant renting of land (see interview notes with local people [Mudavanhu 2000]) but more research is needed before this could be included in the model.
* rental arrangements are unclear.

Privatisation
There may be dynamic processes of privatisation of common resources which the model should capture, eg: as common grazing land is assigned as individual holdings, trees on fields are treated as private resources etc. [Nemarundwe et at 98].

Shifts from open access regimes to co-management
Another aspect of the dynamic in tenure is the emerging processes of co-management of resources in forest lands, for example the involvement of local people in RMCs resulting in relaxing of regulations about access.

3.3 Major players at the landscape level

More work is needed to firm up what social elements outside of households are needed in the model. This will involve unambiguous answers to the following questions.

- What is the influence of the following entities on households?
- What are they influenced by?

If they influence and are influenced by household level or biophysical factors, then they should be included within feedback loops. If they influence but are not influenced by household level or biophysical factors then they can be treated as external factors using exogenous variables.

- Resource Management Committees – should be in the model, influenced by households' social capital levels
- Traditional spiritual leadership, chiefs – should be in the model, influenced by kinship links.
- Forestry Commission – exogenous, except possibly for FPU guards which can be influenced by extreme biophysical events to loosen rule enforcement.
- Cotton companies and other industries (GMB) – exogenous setting of prices and market access.
- Other government agencies (eg: CAMPFIRE), and RDCs – exogenous factors, or out
- Extension agencies – out
- Churches – out

There may be interactions between some of these, eg: due to macro-economic factors. The question was raised whether an economic model needs to be included in order to capture the macro-economic dynamics, or whether the macro-economic factors can be treated as exogenous. Given that these factors are not likely to be influenced by the village level, this would lead us to believe they can be treated as exogenous variables. However, if the model will have several macro-economic policy levers, we need to be careful to think about whether there may be interactions between them. (ie: beware non-independent exogenous variables).

3.4 Policy levers and other external drivers

Price of products.
Rainfall.

4. Social model – ‘household portraits’

This section defines the content and dynamics of the submodel which represents people, their relationships, their resources, their decision making and their activities, all of which are found on the left-hand side of the FLORES model diagram. The first three subsections (social structure, people and their strategies and decisions) are familiar FLORES territory, and so they are quite specific as to how they can be modelled. Please note that this is only one possibility, and it is not set in stone. Proposals for simplifications very welcome!

The final two subsections are about interactions between households (collaboration) and responses to new opportunities (adaption). These are central issues for the ACM research but they will require FLORES to break new ground, so the discussions about how they might be modelled are much more speculative and full of questions.

Each of the first three subsections defines the model in a step-by-step way, by first stating conceptually what the model will express, [then restating it more formally in square brackets in modelling terms]. * Asterisks identify gaps in knowledge and information and questions. ! Shriek-marks suggest how to fill these gaps.

4.1 Social structure

1. In the landscape there are several permenant villages.
[The social model contains a multiple-instance submodel called village].

2. Collections of households form villages in which new households can be formed and can disband. [The village submodel contains a population of household submodels]. Each village has common land [tenure relations between patches and villages], and each contains one household of the village leader or sabuku [household with index = 1], and each is a [variable] distance from markets.

4.2 People

1. People are represented in the model in their household units. Within each household there are assumed to be varying numbers of children, adult men and women, and elderly people, and the gender balance of the household can affect other factors (such as activities and collaborations), but the individuals are not represented as independent decision makers within the model.[The household model contains a submodel for people, with compartments for children, adult men and women and elderly.]

2. Children are born as a result of childbirth decisions [Flow into children, decision variable ‘childbirth’, influenced by adult females and adult males and number of children. Proposed rule: if there are adult men and women and number of children < 6 then childbirth is true else false.]

3. People of any age can die at a health-dependent mortality rate from illnesses and accidents [flows out of all people compartments influenced by a health variable]
* gap: influence of health on mortality rates. Is there a feedback from wealth to health?
! Frank: this should be worked out from national statistics, then made lower.

4. Children ‘come of age’, ie: become adults (half men, half women) at roughly age 14 for girls, 16/17 for boys [flow from children to adults male and female, 50% likelihood of each]

5. Adults ‘retire’, ie: become elderly at roughly age 73. [flows from adults to elderly]
It has been pointed out that people do not ‘retire’ until they are very frail. This raises a question about the model – is the distinction between adults and elderly people actually needed?

6. A new household is formed once a household has more than 4 adults. [flows from adults, and influence to birth of new households containing two adults (women vanish and men duplicate)].

7. A household disbands once all its compartments are empty, plus there is an emigration rate of 2 households per village every 3 years. [mortality of households]

8. New households appear at an immigration rate higher than emigration (eg: 1 per year?) [birth of households influenced by immigration rate]

4.3 Strategies and decision making

The following is a very basic model of household decision making, which has been implemented. In future iterations it will be beneficial to delve more deeply into the issue of decision making, to explore various decision models (eg: from economic theory, decision analysis, artificial intelligence) and to try to match them up with a richer understanding of local peoples' strategies (following examples such as [Frost *et al* 99], [Monela *et al*])

In the model, each household decides, once a year, their livelihood strategy for the year [submodel of household: strategic decision making]

1. Strategic decisions begin with basic needs and available resources. Basic needs is defined as annual subsistence requirement (derived from family size) plus shelter requirement, with a scaling factor to reflect aspirations for consumption above subsistence level (schooling, clothing, culture). There is a positive feedback from the household's resources to their consumption aspirations. [variables: needs, resources].

2. The resources available to a household are their land, their labour, their livestock, their dosh and their social capital. Social capital is a function of the number of friends, kin, neighbours, and club activities.
[influences to resources, from land tenure relations, people submodel, economic submodel, livestock submodel and relations to other households].
* We have begun simplifying by aggregating all the resources into a single value. Is this reasonable? If not, *ie:* the resources must be treated as separate values, what are the conditions for a household to be able to exchange one resource for another, eg: use social capital to make up for a shortfall in labour, or exchange land for money, exchange money for labour etc?

3. A strategy is defined as a prioritised set of livelihood options. Proposed options: growing maize, growing cotton, animal husbandry, NTFPs, collection of firewood and construction materials (poles, rope fibre, carving wood), gardening, beekeeping, contract work (herding, construction).
[decision array variable: strategy (note, in the current implementation there is no contract work, and firewood and pole collection are aggregated)]

4. The household strategy is constructed from a set of livelihood options, each of which has expected outcomes, requirements and associated activities.
[array variable: options (corresponding to strategy), built out of outcomes (corresponding to needs) and requirements (corresponding to resources), and activities (times needed for each activity, corresponding to weekly activity submodel)]

5. The options are ordered according to whether their outcomes will meet the household's needs.
[decision array variable: needed options, calculated by comparing outcomes with needs for each option and ordering accordingly.]

6. The needed options are re-ordered according to whether their requirements can be met with the household's resources.
[decision array variable: possible options, calculated by comparing requirements array with resources, with influence to strategy by re-ordering the needed options according to which are most possible.]

7. The strategy defines how the household prioritizes their activities
[influence from strategy to priorities array in the activity planning submodel]

8. Micro-economics: Each household has an economic submodel focussed on their resources which are added to from income (yields from physical patches and sales of commodities) after their consumption has been subtracted. Surplus can be invested in livestock. Shortfalls (inability to pay for inputs) can be made up by selling livestock.
[annual submodel of household : economics, with compartment resources, with flows in (income) and out (spending and investments).
Monthly submodel of household: yields, which converts yields from biophysical patches to dosh, flowing into a 'yield accumulator' compartment with flow out for consumption, and annual emptying to annual resources compartment]

* How much further detail should the model include of the micro-economics of households, eg: getting credit for inputs?

9. Livestock management: Each household makes decisions about acquiring and disposing of livestock. Livestock will consist of cattle and donkeys.
Cattle are bought to try to achieve 2 oxen for draught power, 2 cows for milking and reproduction and 1 bull for spiritual and status value (and reproduction).
Cattle are slaughtered for a wedding and the funeral of an elder.
Cattle are sold when there is significant shortfall of dosh (economic decision).
Cattle are given as lobola for marriage by the husband's family –1 heiffer to the wife's mother and 10 young cattle for the father, or their equivalent in dosh (Z7000 for the heiffer, 3-5000 for others).
[Livestock submodel of households, with livestock compartment with dispose and acquire flows. Note that lobola is not yet implemented.]

10. Time allocation and activity planning: perceptions, actions and yields.
[We propose using the prioritised activity planning submodel: decision4.sml, modified for seven activities: maize growing, cotton growing, animal husbandry, thatch-grass collection (as proxy for NTFP collection) and pole-cutting (as proxy for wood collection), gardening, and beekeeping, plus addition of two elements in the action array to represent the cattle and donkeys of the household]
* What patch perceptions are the conditions for maize activities and cotton activities (ie: what information needs to flow from the crop models to households)? What is the impact of these activities (ie: how does the crop model respond to actions?)
* How are the livestock herded on the patches?
* What are the perceptions and impacts for thatch-grass and pole-cutting?

The human specification up to this point (except lobola, and contract work) has been implemented by adapting the FLAC framework model. The result is the model zimflores.sml. The links between the social side and the biophysical are currently inadequate (and require answers to the questions in item 10 above). The current heuristics for prioritising the options are very simplistic. The model requires systematic testing and all parameters need to be checked. The 2nd FLAC workshop provided a snap-shot of a household which could be used for parameterisation of household variables, particularly consumption and conversion of yields from the biophysical patches.

4.4 Collaborating and conflicting with other households

Up to now, the FLORES models have all been based on an assumption that decision making goes on within the four walls of a household and thus each household operates independently of each other. This assumption is clearly not valid, and we must address how to model interactions between households.

There are different levels of interaction that we could include in the model, which we can characterise as communication (passing information), co-ordination (doing day to day activities together), and collaboration (embarking on longer term joint ventures). We will also want to consider conflicts. Common pool resource arrangements could also be viewed as a form of community-wide collaboration.

The basic requirement for handling interactions is to include a relation submodel (or more than one) between households in the model. An example would be a relation called 'kinship', which would link households with their relatives. 'Neighbours' would link households which have adjacent fields. Other alternatives include relations between households which are carrying out the same activity, for example bee-keeping, or gardening, or cotton growing, to represent the kind of clubs and other less formal groups of people who get together to collaborate.

More abstractly we may find it interesting to define collaborative groups by means of a single, generic, relation between households (eg: 'in the same group') in order to explore the dynamics of collaboration in general (eg: what happens if we change the average size of groups? What's the difference if groups are stable vs short-term? What results from groups that grow continuously vs those that oscillate in size?). Mandy Haggith is undertaking some modelling experiments on this issue.

Communication:
A good place to start may be to model information passing between households. For example, strategic decisions may be made partly on the basis of information from other households such as the yield per hectare of a crop grown by someone else, or the cost of an option such as buying in labour, or the presence or absence of permission from the Sabuku, or the availability of spare labour in a relative's household, or the possibility of using a neighbour's draught animals in exchange for some other resources. Crop information comes from government/Agritex and is shared in clubs and with neighbours. Information about prices, school fees, regulations about forest resources, and RMC functions comes from village leadership and is shared amongst friends and neighbours. Information passing between households is necessary for any 'copying' of other people's innovations.
* What other information sharing is important? With whom?

Co-ordination:
It seems to be common to work together with other households instead of doing everything alone. For example, a group of people may work together to prepare fields for planting, first all working on one household's field, the next day working on another's, and so on. Likewise, trips to the forest to collect firewood, thatch grass or herd livestock may be done in groups rather than alone. These co-ordinations involve short-term agreements to work together. To model this will require the decisions of several households about where to carry out activities to be combined so that they all go to the same place.
* What are the main kinds of short-term co-ordinations?

Collaboration:
Collaboration between households involves joint ventures. Some examples are: a group of young men deciding to learn together how to grow a new crop such as cotton; a group of people deciding to embark jointly on bee-keeping by forming a club; or a group of relatives agreeing to help each other with money for getting their children through school. Collaboration implies a long-term commitment to co-ordinate activities and share resources. The impact in terms of the model is that clumps of households would adopt similar strategies instead of each household deciding its strategy independently. Other impacts might be cost-reductions of some inputs, greater exchangeability of resources etc. People get information, improved access to resources, and social capital from collaboration.
* Are there other important collaborations? What are the conditions for collaboration? Does collaboration depend on social capital? What do people gain from collaborating?

Conflict:
Interactions between households are not limited to 'positive' collaborations. Conflicts and disagreements are also opportunities for learning and adapting. We should explore whether this is an important element in the model and if so, how it might be incorporated. For example, unequal access to decision-makers like RMCs causes conflict which leads to unequal enforcement of rules.
* What causes conflict, and what are its impacts? How are conflicts mediated?

Common pool resource management:
More sophisticated forms of collaboration include the emergence of new common pool resource institutions, such as agreements to limit individual use of resources to enable fair sharing by all others with the same interests. CPR arrangements might therefore be seen as the result of enduring, community-wide collaborations (Note this links to the tenure subsection of the 'big picture' of the model).

4.5 Adapting to new opportunities and learning

In reality, people continuously learn and change their practices and our model needs to reflect this particularly as the first hypothesis of the ACM programme is that social learning leads to improvements in resource management.
* How should learning be characterised in the model?

It is not going to be possible to do full justice in the model to a theory of learning. However, it should be possible to improve on the current limits of the households in the FLORES model in some fairly simple but fundamental ways. As a first stab, three of these could be: adding some memory of the past, adding some anticipation of the future, and augmenting the strategic decision-making process with the capacity to consider a new opportunity.

Remembering past experiences:
We can give our households memories, so that over time they remember their past strategies and the results of those strategies in terms of impacts on their resources. This could involve simply remembering the facts (3 years ago we did X, the weather was good and our surplus was Y…) or it could involve making assessments of the effectiveness of past strategies (X was a mistake, Z improved our circumstances, if it hadn't been for A and B then X might have been OK.) It is worth noting that in reality people's memories are poor and their ability to accurately reconstruct cause and effect in retrospect even worse. People particularly remember bad seasons/years and generally bad events such as crop failure, livestock deaths, forest sanctions. Questions remain about how people use their memories when making plans.

Anticipating future outcomes:
Most standard economics models of decision making involve anticipated costs and benefits of options. The period of anticipation can vary indefinitely, as can the factors anticipated. Most people's ability to predict the future is not much better than their ability to remember the past. But other aspects of the future may be very important, notably children and old age, hopes and aspirations, and fears or expectations. Questions remain about how people bring the future into their planning.

Adding new options to household strategies:
Choosing from a fixed list of options is not a good basis for learning. The space of possible strategy options within which adaptations can be found needs to be dynamic. In other words, it is going to be essential to allow the appearance of new livelihood opportunities in the model. Then there needs to be a way for households to discover the new opportunities, and recognise them as new. Such discovery is not uniform. Perhaps an innovative household will begin doing something new, and discover that it is an improvement and then the new idea might infect other household's options (through collaboration pathways, perhaps). Perhaps the model should include education, extension and marketing processes which can cause change from outside. The heuristics that households use to come to strategic decisions need to adapt to the new possibilities. But we probably also need to model reluctance of households to change their strategies.
* How do new livelihood options appear? What factors enable or drive uptake of new ideas? What factors prevent change and lock people into old strategies?

Given the abstract nature of these issues, we will need to explore them through particular case studies, for example, the change from getting honey from the forest to keeping bees in hives, or the spread of cotton growing.

5. Biophysical model - 'close-ups of forest, vlei, farm and fire'

5.1 Livestock

Livestock are defined as the sum total of all the animals in the homestead. Those animals that are raised and bred by households include;
1 cattle
2 donkeys
3 goats
4 sheep
5 pigs, will all be included under this category.

Livestock are born, grow, reproduce and die.
The stages of the livestock's lifecycle are: calf, juvenile, mature cow or bull or oxen, and oldies
The size of the livestock compartment may fluctuate when livestock is bought or sold.
Cows give birth to a single calf at a time and will give birth to five calves in their lifecycle.

- I do not have the statistics of the chances of a cow giving birth to more than one calf.
- The chances of a calf being a male or female are equal

•Cattle have known grazing regimes and preferences. Given a choice cattle would graze on grass species A over any other species. If that is not available then they focus their choice on the next available preferred choice.
Cattle grazing is known to have a stimulating effect on the regenerative power of grass (Ref?…)
•Other significant livestock in the Mafungautsi case study are donkeys. These are somewhat different from cattle in that they provide draft power only and not meat, milk or hides.
Food grass preferences of donkeys are of much poorer nutritional value than cattle. Donkeys prefer Tsangadzi (*Cynodon spp.*), an infertile soil grass species.
Utility value of donkey is much higher than cattle e.g. a donkey can comfortably carry a 50kg bag of grain on its back. The same weight would break the spine of an ox. Also, a donkey delivers significantly more hours of labour than an ox.

- I do not have most of this data yet. Some of the statistics are known already but some may need to be researched on. Need help here identifying what is available and what is not.

[Note that the livestock model will actually be placed inside households, in order that the model knows whose livestock are whose and in order that decisions about sale, purchase, slaughter, reproduction etc can all be taken as part of the strategic decision making and economics of the household. Herding of livestock is one of the household activities.]

5.2 Grass

In addition to grazing for livestock, other grasses of major interest here would be:
Thatching Grass – Hyperrehnia sp.
Broom Grass – (Scientific name?)
Both grass species grow in the vleis although broom grass is less drought tolerant than thatching grass.
Both species are perennials that sprout new leaves from the same root stalks when the rains fall. Thus harvesting of the grass does not effectively destroy the plant stock.

5.3 Crops

Crops have the following properties;
1 Species
2 Varieties

Major field crops are cotton, maize, and groundnuts in the open fields.
Major vlei garden crops are vegetables (annuals e.g. Beans, Peas, Tsunga, and perennials e.g. Covo, Sugar cane, Bananas). They are irrigated and harvest is possible all year round.

Field crops are planted when the first rains fall and they grow according to a known growth pattern. Yield of harvest from a particular variety of crop planted can be calibrated from known estimates.

The exact location in the field patch where a particular crop will be grown will be determined by other factors from the LHS.

5.4 Forest

The forest model would show growth of a tree species in relation to competition for both nutrients, water and sunlight. The forest is made up of an average of 15 woody species and several other non-woody species.

Growth of the forest will be split into the seedlings, immatures, mature and canopy status trees.
1 Seedlings – those plants that would have germinated from the seeds
2 Immatures – also known as saplings young adult trees that haven't reached reproductive age.
3 Matures – the trees of reproductive age
4 Canopy status – the trees that have attained their full growth potential and really are growing old.
A tree naturally dies after attaining canopy status but could also die of unnatural causes such as being cut down by wild-honey seekers. The major limiting resource in the forest that determine the distribution and growth of the tree species is water availability and sunlight. Tree species can thus be mapped out according to their water and sunlight regimes.

Gap dynamics an important aspect as it determines the ability of seeds to germinate on the forest floor. A gap is created when a tree of canopy status dies and falls down. The sunlight that illuminates the forest floor will then enable the seeds to germinate and grow quickly to fill the gap.

Termite sub-model
1 Termites collect leaves and dead wood to the underground
2 This has an effect on the fuel load available for forest fires
3 Termites are also responsible for the cycling of nutrients in the forest

Termites have an influence on the forest structure as they are primarily responsible for the breaking down of all leaf litter and dead trees.
Termites thus recycle the forest and also gets rid of the fuel load that could be of significance on the severity of a fire event in the forest.

5.5 Firewood

Firewood defined as the wood harvested from the forest for the purposes of providing energy for cooking and warming and socializing.
Falls under three main purpose branches.
1. Firewood for domestic cooking, that is for daily meals cooking. Firewood for special occasions such as funerals, weddings, brewery and baking bricks.
2. Firewood for 'spiritual fire'
(Without attempting to be superstitious an African family attaches a 'spiritual' (for lack of a better word) value to a fire. Which is the reason why even if nothing is cooking on the fireplace and there is no need for heating, a family would still light a fire in the kitchen and the men and kids would light theirs on the 'Dare' outside. There is even a social expression of *Imba inopfungaira utsi* which would literally mean that a home is only home when there is some smoke coming out of it.)
3. Finally there is firewood that is harvested for sale.

Quality and dimensions of trees selected for firewood would depend on the purposes for it. Generally:
1. For household cooking the species are those that emit low levels of smoke and ash and are of high energy value per unit weight. Such firewood would be required to be of small dimensions that can conveniently be used inside the kitchen.
2. For beer brewing, funerals, and backing bricks the choice is of whole tree trunks
3. Some tree species such as Muparamhosva (*Ochna pulchra*) are strictly prohibited from lighting as firewood for spiritual reasons. Others are prohibited from using as firewood for ecological reasons.
4. Harvesting of firewood in Mafungautsi is restricted to dry and dead wood and in any case it is allowed only on one day in a month.
5. The foreseeable effect harvesting firewood on the ecology of the forest would be shed the forest of dead wood and thus allow the rejuvination of the forest. Also, harvesting reduces the fuel load of the forest available to events such as fire.

5.6 NTFPs

This category includes the thatch and broom grass (see grass model) that is harvested from the forest but also of interest are the mushrooms, fruits, worms.
Most of the NTFP are harvested at specific times of the year that are consistent with the physiological pattern of the product.

5.7 Rain

Rainfall is a seasonal event in Mafungautsi and its onset acts as a trigger that puts a whole bunch of biophysical processes into motion.

5.8 Fire

Fire an important phenomena in the Mafungautsi forest with wide apparent evidence of fire incidences having recently occurred.
It would appear that the fires could be classified into
1 Man caused , by wild honey gathers
2 Natural fires – started by lightning or other non-human induced phenomena
Fires classified as
a) Early fires – those that burn during the early months of the year when the moisture levels are still high and the grass wouldn't have matured. Such fires cause the most damage to grass species and minimal damage to woody species.
b) Late fires – these burn in winter when the environmental conditions are dry. Late fires have the greatest impact on the woody species and in fact are labeled 'Hot' fires.

5.9 Wildlife

So far I'm only sure about Zebras as having an impact on the biophysical side. I'm yet to investigate other animals such as warthogs, pigs and bucks.
Zebras would have the same grazing and reproduction regimes as donkeys. I THINK.

6. Implementation plan – 'the movie'

'Knowledge is more like a dance than like a picture'.

The most important thing about implementation is to view it as just one step in an iterative cycle of model development. At the specification stage it is assumed that we are already several steps into the model development cycle, having already gone through several earlier stages:

Step 1: Articulation of the purpose/issue/focus of the model
Step 2: Boundary selection, timelines/reference norms
Step 3: Conceptualising/hypothesising the core system dynamics (dynamic hypothesis)

Depending on which modelling bible you read (for example: [Forrester 61],[Morecroft & Sterman 94], [Kim 95], [Sterman 2000]), these steps are variously described. The process so far, for example at the Gwai workshop, has involved stepping through these phases in a rather haphazard way, and it would be beneficial to think about returning to them and working more self-consciously through them. At the moment, different people in the team may have different views of the purpose of the modelling exercise, and different core hypotheses, or may still be unclear on these issues. Achieving a clear consensus on these topics may help to energise the process, though we need to be sensitive that a blurred focus can help a broad group of people to see the process as relevant to their own agenda, whereas a tight focus may exclude some people's interests.

Step 4: Formulation
We are here! The current phase of FLORES model development is 'formulation'. We should think about this phase of the modelling process as a smaller 'wheel within the wheel', including repeated cycles of:

- specification of the model,
- implementation in a computer-based simulation model,
- consistency-checking and debugging.

We already have a running SIMILE implementation of the basic FLORES model, adapted from the FLAC framework model, which incorporates all of sections 4.1, 4.2 and 4.3 of this specification, and some of section 5. This step involves incrementally iterating through more detailed specification of sections 3, 4.4-5, and 5; implementing them in SIMILE; and debugging them to eliminate crazy behaviour.

Step 5: Calibration and Testing

Then we need to move on to testing the model in earnest. This will involve
1. Testing Content: rigorously questioning each model parameter and equation, matching it to the knowledge and data we have of the Mafungautsi sites.
2. Testing Extreme Behaviour: systematic tests of model behaviour, during multiple model runs, varying parameter values to extremes to check for bizarre and unreasonable results.
3. Testing for User Relevance: Can the model stakeholders actually use the model to answer their questions?
4. Sensitivity Testing: If major content changes have been identified by this stage it is probably best to move smartly along, and skip this stage. The better the model is, the more testing should be dwelt on. If the model is robust enough to survive the previous levels of tests then sensitivity analysis can be used to reveal which variables are key factors in producing important behaviour changes. If bizarre behaviour is revealed, the origins of which are not understood, then sensitivity analysis can reveal them.

Step 6: Using the model and evaluating impacts
If the model is robust enough to reveal that desired outcomes may occur as a result of changing key variables by policy interventions, then the model can be used as the basis of real-world action, followed by monitoring of the impacts of the action, in order to observe if the model-predicted outcomes are achieved. However, if the model testing has revealed that the model requires refinement, then it is likely that this step will be skipped over.

Step 7: Reflection and documentation
Ideally each step in the process should involve documentation, but at the very least, having completed a model, tested it and maybe applied it, time should be taken to reflect on what has been learned, and this should be documented.

And round again…
There is no such thing as a perfect model, so having reached the end of the cycle and learned some valuable lessons, the model development cycle should begin again with step 1. Having moved through the entire cycle once, it should become much easier for the team to articulate the model focus, clarify the boundary of the model, and formulate hypotheses of expected dynamics which will in turn lead to a much improved model.

It is very important for us not to get stuck trying to implement a highly complex version of the model in the first instance, as this will be time consuming in itself, and make the testing stage much more difficult. It will be much more fruitful, in the longer term, to be highly selective now about the elements of this specification which we implement first, before moving onto calibration and testing, in the expectation of returning to the start of the loop, wiser and more experienced in the modelling process, and able as a team to build a better model.

Plan of action
First we will ruthlessly select a subset of the content of this specification document for implementation and debugging. Then we will move rapidly into testing mode, calibrating the model as fully as possible, testing it for extreme behaviour, and testing it with all the model stakeholders to assess its relevance to their needs. We will learn a lot about the model, our fellow modellers, and the modelling process. Testing a prototype model will give us a much clearer idea of what a better model would be like. That's the model we will then develop!

In particular, we intend to have a working basic simulation model running by the end of November 2000, test it during December, reflect on it in early January 2001. We will begin a second iteration around the modelling cycle with the FLAC workshop at the end of January 2001. In this second cycle we will aim to move the model closer to core ACM issues such as communication, and to calibrate it more richly in Mafungautsi, ready for evaluation in March.

Alternative iterations
If the team likes the iterative approach, we may want to think about variations for future iterations.
1. Soft systems approach: See [Checkland 81], [Wilson and Morren 90]. These approaches may allow us to better address some of the human issues, and to generate more future-oriented model ideas.
2. Single issue mini-models: We might want to do some very focussed exercises to model some interesting issues without using the full FLORES framework, in order to iterate more rapidly in the hope of gaining some good insights which could then feed back into the FLORES process. For example, we may want to break out of the FLORES framework to address some non-spatial issues.

Finally
The model is of local people in Mafungautsi. How can they become engaged in the modelling process? It would be great to enable local people to critique the (conceptual and/or computer) model as it develops.

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Contacts and acknowledgements

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Record of the third FLAC Workshop

January 22nd-26th 2001, CIFOR, Harare, Zimbabwe

Mandy Haggith, Jasper Taylor, Happyson Mudavanhu

Summary

This is a record of the third workshop on FLORES Adaptation and Callibration (FLAC) held in Harare, Zimbabwe. Its purpose is to provide a summary for those people who were unable to attend. It steps through objectives and achievements, summaries of the five days' activities, participant reports, future plans and evaluation. There are also various appendices:

- a workshop participants list
- the workshop schedule
- some 'cheat sheets' used in the workshop
- an outline paper
- 'hints and tips' for some common SIMILE equations

The emailed version of this report also has attachments of SIMILE models built by the participants.

Objectives and achievements

Desired outcomes (set prior to workshop):

- Improved SIMILE and FLORES modelling capacity, particularly increased confidence with the equation language and relations.
- Running, tested models.
- Plans for future FLORES modelling work by workshop participants.
- A joint draft paper on the Zimbabwean FLORES work.

The first three of these were achieved. There was some discussion of a paper on the Zimbabwean FLORES process at the workshop, and a possible outline of a paper is appended.

Day 1

All participants were first of all invited to think about their hopes and expectations for the workshop and write them on cards, which were grouped on the pinboard. These were used for evaluation purposes at the end of day 2, and at the end of the workshop. For details see the notes from Day 5.

The proposed schedule was agreed (see Appendix 1).

A very brief discussion of intellectual property rights ensued, in which everyone agreed to share their models, as long as they are credited for their ideas. Jasper agreed to find out about the waivers which people in the free software community use for agreeing conditions on sharing their work. Godwin noted that it is time for the FLORES group to 'copyright the process'.

Jasper outlined the FLAC process, led a SIMILE refresher session and announced the new features in SIMILE 2.1.

Refresher course on FLAC and Simile.

First we went over the history, motivation and design of the FLAC project. I (Jasper) recalled that the project was aimed at local scientists studying situations in which human pressures on communal forest resources are resulting in deforestation and degradation. The idea was to enable them to create or adapt models within the Flores paradigm in order to analyse such situations.

I (Jasper) then did the refresher tutorial on Simile. There were three people present who had not seen Simile before (Tendai, Kuda and Sola) but I wanted to try a novel approach, so rather than starting with a blank screen and building a model I started with step 5 from the tutorials, and described what was present on the diagram as follows:

* There are two top level submodels on the diagram. These represent two interacting systems

* All the influence arrows between these submodels run from the top one to the bottom one. Therefore the behaviour of the bottom one is influenced by the top one but not vice versa.

* Both the submodels have the 'stack' on their graphical representation. This shows that they are multi-instance, fixed membership.

I (Jasper) then concentrated on the top submodel, "Tree". I pointed out that:

* It has a single compartment. This is a rough representation of the size of each trees.

* There are flows in and out representing accumulation and loss of material

* There are some variables influencing the flows, representing parameterization of these processes

* There are two separate variables with randomized values, representing X and Y coordinates for each instance.

At this point I showed the behaviour of this submodel, using first the graph helper then the lollipop diagram.

Next we had a look at the lower submodel, noting that:

* There are three compartments rather than one. I described how material enters the crop component as sugar, then gets converted into leaf or grain biomass according to the partition function.

* There are X and Y co-ordinate variables, but these are functions of index(1) rather than random values. This allows the instances to be placed on a regular grid.

* The growth flow is affected by the shade variable, which depends on values from the other submodel.

Here I showed the behaviour of this submodel, with the lollipop diagram. I pointed out that the lollipops could be taken to represent either individual crop plants, or total biomass in each grid square - perhaps over a number of individuals.

I then described the way the shading influence works. In this model every tree has some shading effect on every crop square -- there are no relations.

In general this session was a success, with people getting a good idea of the motivation and capabilities of Simile modelling.

New features of the latest version of Simile

The participants who were already using simile had a mixture of 2.0 (from the September workshop) and an early 2.1 (from the November workshop). However as I hadn't been there to describe 2.1 before I covered all the features new since 2.0, notably...

* Tools are all in the model window now, no separate toolbar

* 'Preferences' at bottom of edit menu, allows setting behaviour (Including an explanation of each individual feature)

* Find a component by matching a substring of its caption (doggie)

* Most recent files come up in file menu for reopen

* Popup info for influences reveals names of components at ends

* Helpers are now called I/O Tools, and come up in a cascade menu

* Several obscure internal changes to increase speed, and possibly some bugs
  -- this is pre-release

* Help menu !!!

Tutorial on the equation language

This was difficult, because the equation language is not really a 'language' -- merely a collection of functions for doing different things. In order to overcome the obvious timidity with which most people approach the equation dialogue box, I started by demonstrating the sketch graph function to implement a seasonal rainfall variable, then substituted it with some mathematical functions.

I set out to cover the more common confusing points:

* Element, for picking individuals from arrays

* sum(), greatest(), etc, for handling lists

* rand() and index(), for assigning different values to different submodel instances

* Mathematical functions, starting with the commonly used fmod() and hypot() -- included searching the help system with the keyword 'round' to find the floor() and ceil() functions, which perform rounding

* last() and prev(), for handling persistence over time

However there are plenty of functions we didn't get onto, including the population-specific functions parent() and channel_is(), the array constructors makearray() and place_in(), and the array distribution function colin().

In any case, despite the emphasis on use of the help system, this session seemed to do little to remove the perception that the equation language is opaque and difficult.

Tutorial on relations

I started this with the model we had looked at earlier, the shading model, and went through the process of replacing the any-to-any connection between the two submodels with a relation connection. However, the session quickly departed from the planned sequence of events and turned into a series of attempts to explain what was going on in a relation submodel by means of a series of diagrams, verbal descriptions and exercises involving cards, and while these did not form a coherent sequence that could be described and replicated, Ravi claimed to have heard "the sound of pennies dropping".

One representation that seemed to work for some people was of instances of a relation model as nodes on a grid made by drawing intersecting groups of lines representing instances of the base models. The relations condition has the effect that only some of the intersections actually have model instances. If you are on a grid intersection, i.e., in a relation model instance, you can see one instance each of the two base models, which is why values from them are scalars. However if you are at the end of a line, i.e., in a base model instance, you can see a whole row of intersections (although the number actually corresponding to relation model instances is variable) which is why a value coming from a relation model forms a variable-length list.

This ended up being quite a successful session -- during the subsequent model-building sessions, Herry produced a model including several relations, most of them built correctly, without much further tutoring. For the people starting out, there was probably not much point in covering the mechanics of relations at this stage -- a few more demonstrations of what could be done with them would have been better, but these had to wait until the following day.

Tutorial on data and GIS issues

This was done with a practical demonstration of how to set up a model of a group of contiguous polygonal patches with data from a GIS.

Since those members of the group interested in using GIS were working with a variety of different systems, I decided to skip the process of exporting data from my own GIS (Arcview) and assume that we already had the data in some form in which it could be loaded into a spreadsheet. I then illustrated how to organize the data as a series of columns with headers, including one for the instance indices, and export it as a .csv file

The saved file was used by Simile to pick up a series of values for the X and Y coordinates of the vertices of polygons -- I kept this simple, using a separate data column for each co-ordinate and making the co-ordiante arrays in separate variables. This was done with simile's 'load table' feature, which incorporates table data as constants into the model program. I pointed out that there was soon to be another mechanism, which would allow the table data to be read in as parameter data to a running model, and that the interface for doing so would look very similar -- this has since been achieved.

Finally I showed how another table, this time containing data relating arcs in the diagrams to the polygons on either side of them, could be read in the model and used to establish a neighbour relationship among polygons. The main point of doing this was to build a model in which an elephant went round eating vegetation and crossing from polygons to their neighbours, to show the functionality of a neighbour relationship. The actual mechanics of building the neighbour relationship from arc data are complex, requiring a relation between polygons and the arcs bordering them by which a satellite model listing the polygons on the other side of the arcs could be generated in the polygon model, but I did not try to explain this. In any case the process will be simplified when it becomes possible to set relation model memberships by testing values from one base model for equality with the index values of others.

This session was successful at showing what could be done with GIS data and how to prepare a data file for reading into a Simile model, and also as a further demonstration of the uses of relations after yesterday's discusion of their workings, but the actual process of loading data files into simile did not come over well. In any case the state of affairs has changed now there are file parameters.

Simile wish list resulting from workshop

* Plug and play should be more intelligent.
* Zoom-to-fit should be in the navigation bar.
* Delete is too imprecise -- put it on a right-button menu?
* Clear top level all at once, and empty its properties too
* Drag window background to scroll it

The participants then had a brief hands-on session with the latest FLAC CD, giving everyone a chance to try out the new features, and for people new to FLORES to look at the framework model.

After lunch, James Gambiza gave a presentation of some participatory modelling work being carried out with communities in Dande. The work is led by Tim Lynam at TREP with Frank Chinembiri and Bright Mombeshora. It has resulted in a SIMILE model, conceptualised by local people, implemented by Tim, evaluated in the communities and approved by local people, and used by them to consider future scenarios of land use change. The result is a process of multistakeholder meetings to make decisions about future land allocation.
In the afternoon, Jasper ran tutorial sessions on the equation language and relations (Jasper to add details).

Day 2

First, Mandy gave a brief presentation on the modelling process, emphasising its iterative nature.

Then Happyson, Herry, Maxwell, Muyeye, Wavell and Sola gave presentations on their modelling progress, the purpose of their model, its expected behaviour, a conceptual model diagram, and any problems. Each also set targets for the workshop.

Happyson has been working on the model of Mafungautsi forest and three neighbouring villages as part of the Adaptive Collaborative Management programme at CIFOR. His major target was to work with the rest of the ACM team to begin callibrating the current model, and practice working with submodels as the main problem is that the whole FLORES model is too complex to work with (it takes too long to compile).

Herry has been conceptualising a FLORES model representing Paser, Kalimantan, Indonesia with the objective of creating scenarios of improving communities' well-being and improving forest cover. His workshop target was to plug and play submodels from the FLORES submodel library and get his model working.

Maxwell has been conceptualising an economic NTFP model, particularly looking at the contribution of NTFPs to household economies.

Muyeye has been working on his model of demand and consumption of firewood (and other energy) in urban areas. His target for the workshop was to add impact on forests to the model, and the influence of availability on price, and to 'turn the red model black'.

Wavell has been working on a supply-side model of NTFPs, specifically wood carvings, thinking about various aspects of the model including species preference, economic and social aspects of household decision-making about NTFPs, resource access arrangements, and market issues. He proposed to work with Muyeye and Maxwell during the workshop.

Sola has not been working on a model yet, but the model she wants to build would be a model to act as a monitoring tool for SAFIRE, to help them assess the impact on forest resource of their interventions with communities such as product and market developments. It would be a FLORES type model of household decisions about forest resource use, mediated by tenure, making the roles and values of a range of forest resources explicit, and having influences such as technology, skills, capital and the market, on forest resource management and use.

Before lunch, participants began to organise into modelling teams.

After lunch, Mandy presented her social capital models. This was largely to give a concrete example of a relation model, as participants had asked to have some additional time spent on relations. There are three models. All represent a community as a population of people, each of whom has a single feature and a single compartment representing social capital. There is one relation between which represents social networking based on the value of their 'feature', and different configurations of this relation lead to different distributions of social capital among the community. The first model is a model of distinct bands or social strata or classes. The second model is of membership of a group (such as a church), with people moving in and out of the group. The third model is also of a single group, but this time it recruits continuously, and the definition of social capital generates sudden losses of social capital as a result of 'sins', as well as gains of social capital through networking.

Then Jasper took over for another session on relations and a session on data and GIS (Jasper to add details).

At the end of the afternoon, a brief evaluation session revealed that participants' learning targets were being met or exceeded. There were requests to get on with hands-on work with SIMILE. There was some disappointment expressed about some missing participants, leading to a lack of continuity from previous workshops.

Day 3

The particpants divided into three modelling teams.
1. Mafungautsi – Happyson, Ravi, Frank, Tendai, Richard.
2. Market – Muyeye, Kuda, Maxwell and Wavell
3. Kalimantan – Herry and Sola.

First of all participants were asked to think clearly about their targets for the next two days. They were given a sheet to fill out to help with this. (See Appendix 3).

The rest of the day was spent hands-on, each team pursuing development of their own model.

Day 4

The modelling work continued in the same groups.

The Mafungautsi team came up with a card game for participatory callibration of their strategic decision making model.

Sola had gained confidence in working with SIMILE and she began working on her own, adapting Herry's Kalimantan FLORES model to reflect the situation of communities in Zimbabwe. This seemed to reflect the true spirit of FLAC - adaptation of the FLORES framework model to reflect the Indonesian situation and then further adaptation back to Zimbabwe!

Herry added timber concessions to his model.

Muyeye's team developed the energy model so that the firewood harvest impact involved multiple woodlands at increasing distances from the urban centre, with price reflecting transport costs and feedback from forest biomass into firewood price through stumpage fees.

Towards the end of the day, some sheets were distributed to help with thinking about testing and callibration. (See Appendix 4).

Day 5

The morning was dedicated to presentations from each of the four teams on their progress during the workshop. Brief summaries of these follow.

Mafungautsi

(Happyson, Ravi, Frank, Richard, Tendai)

The objective of the modeling clinic was to understand and calibrate the People submodel and the Strategic decisions submodel. The two submodels were explained to the Mafungautsi group and amendments to the nature of the equations and the calibrations were made with the recommendations of the field based sociologists. The two submodels were calibrated to the extent of being able to produce some simulations of the various variables of interests. However, it was noticed during the calibration that some essential data on the process of prioritization process of activities needed to be gathered from the field.

Markets

(Muyeye, Maxwell, Kudakwashe, Wavell)

My objective at the workshop was to get in depth understanding of using simile, especially the equation language, and also to develop the urban fuelwood model into a running model, at least with abstract data. A lot of time was spent developing the model, and in the process insight in the technical aspects was gained. From a conceptual model, a red model was constructed, and calibrated into a runnable model. Although by the end of the workshop a lot of work needed to be done, especially on the relationships in the model, the work helped in the identification of areas where specific theory is required, and areas of data collection in order to calibrate the model. Technical hands on facilitation of the modelling exercise helped a lot to achieve progress. The model developed will be used in my research project on the linkages between urban energy consumption and the environment, and also in the other areas of my involvement within WWF.

Kalimantan

(Herry)

The ACM and FPP programmes set up a collaboration to do research on "A System Dynamic Model for Creating Scenarios of Adaptive Collaborative Management of Forests: A Case Study in Paser, East Kalimantan, Indonesia". The research is aimed to answer research questions formulated as "what scenarios or options of adaptability and collaboration of forest management can enhance sustainability and human well being?". The research hypotheses were formulated as follow:

a. There are some scenarios can improve the sustainability of forest cover and human well being.
b. If there is collaboration among multi stakeholder then the quality of forest cover and human well being will increase.
c. A Multi stakeholder forest management gives better results in terms of sustainability and equitability than a single-stakeholder forest management.
d. Dynamic multi-scenarios yield better than any single scenario over time.

The research is conducting with the following steps

1. Conceptual-Model formulation: State the model objectives, bound the system-of interest, categorize the components, identify relationships, represent the conceptual model and describe the expected patterns of model behavior.
2. Quantitative-Model Specification: Identify the functional forms of the model equations, estimate the parameters, represent it in SIMILE and execute the baseline simulations.
3. Model Evaluation: Assess the reasonableness, compare the model behavior and the expected pattern and the real system.
4. Model Use: Develop scenarios, testing the hypotheses mentioned above and communicate the results.

The research takes place at CIFOR (deskwork) and in a field i.e. Paser District, East Kalimantan. The site is characterised by existing natural forest, forest dependent people, forest actors, forest stakeholders and moderate level of conflicts. Although, the model will be developed for ACM site in East Kalimantan, the main components of the model will also be applicable for ACM site in Jambi.

Project development, impact monitoring and evaluation model

(Phosiso Sola)

Purpose: To investigate the impact of resource commercialisation on the resource status (standing stock) and the livelihood dependent thereof (income).

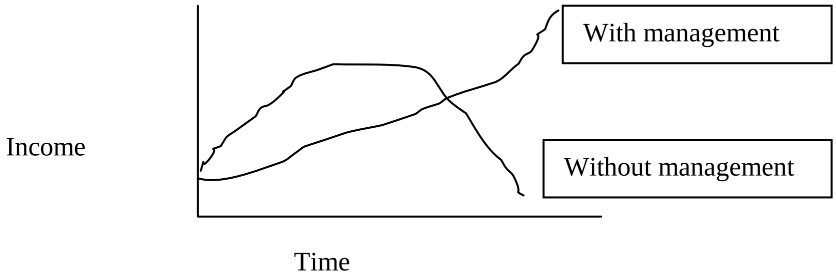
Objective: To design a tool for project planning and impact evaluation within the Safire MITI project.

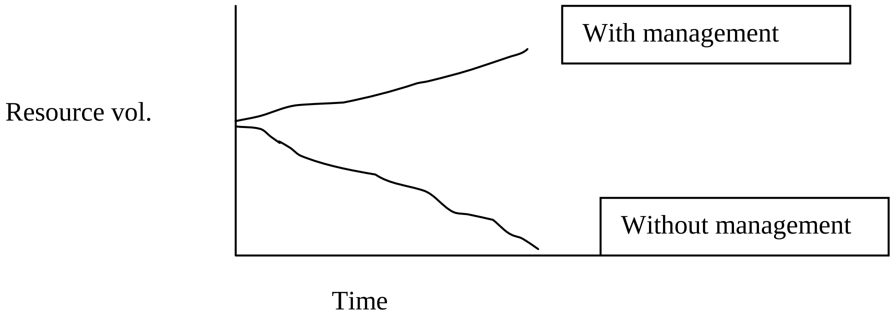
Approach: Prior to project implementation, using baseline data the model will be used to predict the potential impact of resource extraction on community income and resource status. This will be done so as to develop, test and evaluate management strategies to mitigate the impacts. During the project life the model will be periodically used to predict the potential impacts of recommended extraction rates (harvesting: techniques, volumes, frequency..) using the determined resource performance attributes (standing stock, recruitment rates, mortality, growth rates.

Model structure: The model will consist of three main submodels namely the community, markets and technology and the resource base submodels. ***The community submodel will consist of income submodels from crops,***

livestock, timber, NTFPs and other livelihood strategies. In the resource base submodel will be the crop field, trees, NTFP and grass submodel. *An addition to the presentation)*

Expected behavior





Tenure

(Mandy Haggith)

One of Mandy's objectives for the workshop was to revise the way tenure is modelled in the framework FLORES model. The framework model's concept of tenure is that of exclusive ownership of patches of land by households. All patches are exclusively owned and only the owners can perceive the conditions of patches or carry out activities on them. The tenure relations were also fixed over time. The revised model has three different kind of tenure relation, and different kinds of rights are associated with each type.
1. Exclusive - patches are fields belonging to a household and households have the right to cultivate these patches.
2. Village commons - patches belong to a village, but no particular household in the village (represented as household with index number 0), and all households in the village can perceive these plots and plan to do activities on them, they don't have rights to cultivate but they do have grazing rights.
3. Other common land, such as state land, which belongs to no particular household or village, and can be perceived and acted on by anyone, and on which households have rights to collect forest products and graze. In addition, the tenure relation is dynamic - when households disband their fields go to a village pool, from where they are reassigned to new households.

Evaluation and Future Planning

In the afternoon, Ravi led a session evaluating the workshop in terms of the extent to which it met participants' hopes and expectations, things that went badly, and things that went well, things that went badly and well with the FLAC workshops in general. Then he led a session of future planning, and finished with a round of peer contracts. The results of all this follow.

Hopes and expectations

(numbers reflect ticks on cards as part of evaluation)

Households interact in the model 0
Help finish draft 1 of Mafungautsi flores 1
Develop and implement a running model 5
Develop a market centred model on commercialised forest products 2
Get to work on own problem in practice 1
Play around with our team model 2
Use my new skills to develop a simile model for Dande CA
To make my model work properly 1

To understand about relation models 1
Get familiar with SIMILE and FLORES framework 2
Learn about new features in SIMILE 3
Learn more on SIMILE, ie: equations 2
Gain insight into SIMILE 1
Familiarise with FLORES model 1
Enrich modelling skills in SIMILE 4
Improve my modelling skills 3

To learn about modelling and its usefulness 2
Some important things can't be quantified, how can they be incorporated into models? 1/0
To know how close models are to reality 1/0
Better understanding of modelling process 3
Share ideas on modelling techniques 2
Learn modelling steps/process 2
Get modelling demystified 2

Find out how people think about processes – graphically? 0
Learn how to expain modelling with SIMILE 3

Draft paper on FLORES process in Zimbabwe 0

A commitment to continue to share our process, knoweldge insights into relationships between people and miombo woodlands
Learn about how other others have been doing 2

What went badly (this workshop)

Time drags a bit too much
Time management
Time wasted through chatting/talking
Venue was prone to disturbances
Not enough time on hands-on
Insufficient attention to equation language
Few attendants
Level of attendance
Computer crash when running FLORES with new SIMILE
Too many 'Gotcha' problems with SIMILE

(Discussion – we should have adapted the programme to meet some objectives identified at the beginning. Facilitation could have been pushier to cram more into the time. Attendance changes and each want a different pace. However, pushing the pace would tire people out even more and make the atmosphere less relaxed)

What went well (this workshop)

Hands on practice, with facilitation
Hands on work on models
Introduction to FLAC, FLORES, and SIMILE
Understand SIMILE and FLORES
Very focussed practicals, hands-on
Team spirit
Explaining relations in SIMILE
The workshop was quite informal and made learning easier
Complicated stuff was explained well
Clarification of the modelling process and use of SIMILE
Interactions on specific models
Hands-on explanations – running model
Relaxed informal atmosphere

What went badly (FLAC workshops in general)

Team dynamics – changes throughout disruptive
Participants continuity
Participants levels of understanding too diverse
Inconsistencies in attendance and participant composition
Most workshops did not adequately cater for beginners
Too much tutorials and less hands-on time
Relating activities to the framework model

What went well (FLAC workshops in general)

Sharing experience from others
High levels of interest
A simple running model
All I know I could be a modeller!!!
Good backup & follow-up with informal meetings
Learning about FLORES and SIMILE in detail
Getting on with modelling and systems thinking

Future Planning

Should FLAC workshops continue?

Yes - as ways of sharing experiences
Yes - in a way which is more audience responsive
No – unless there is continuity of participants

In what form?

There should be a core person who keeps in touch with everyone and knows what everyone is doing
How often – 3 times per year
How long – depending on objectives
With clearer objectives
Informal meetings should be at least once a month
There should be targets that they do between workshops
Maybe there should be smaller groups of modellers around more focussed modelling goals (eg: the market/NTFP group)
The content of the workshop should be clearer

The programme should be developed locally, and that should determine what kind of resource people need to be brought in
Need ways to help new beginners join in the process.

Models : Will development of the models continue?

Yes from all participants

How, with whom and in what timescale? (notes from a verbal round)

Mandy: Within the ACM programme. By helping Happyson and the Mafungautsi team. By synergy with other model developments such as SAFIRE's. In this calendar year. As fast as possible.

Sola: By selling the modelling process in SAFIRE. By working with the other teams. By working on callibration. Over the course of the next 2 years.

Herry: Within the ACM research in Kalimantan. With the ACM team in Kalimantan, and Ravi. Can callibrate after field work in February. 2 months.

Frank: To pursue strategic decision and labour allocation for household monitoring and understanding their strategies. With the Mafungausi team. By the end of this year to write something. Also with other teams, like the FC people.

Richard: To make it a real participatory monitoring process getting local people involved in callibrating the model, and using the model as a learning tool and for learning about policy levers etc. How? By involving local people more. With the ACM team. Over the whole period of the ACM project.

Wavell: To move on from econometric modelling and get involved in a more interactive modelling process and develop a reasonable NTFP model involving people making decisions, tenure. How? By library shopping, tinkering with the submodels that already exist. With whom? With Happyson and FC people. Over what period? 12 months.

Max: To look at key NTFPs contribute to the economics of households. With the other teams. Over the next 12 months.

Muyeye: To develop his model linking urban consumption to the environment, to be meaningful in the local context and explore how relevant it is to other settings in the region, like Zambia, Mozambique. Within WWF. In collaboration with Kuda, and with backup support for SIMILE from other people in the FLORES context. To see meaningful results in the next 12 months.

Kuda: To embark on modelling habitat change in CAMPFIRE districts, to model habitat fragmentation, within a WWF project, drawing on Happyson and Muyeye and other WWF team members. Will want technical support from Jasper and Mandy. Within 18 months.

Happyson: To start callibrating the model and getting local people's input. Within 2 years.

Tendayi: To work with the local communities to callibrate the model so that it comes closer to their views. Within the ACM programme.

Ravi: Will seek some funding to allow the process to continue, and to promote collaborative modelling efforts.

Individual plans (from cards)

Sola: Continue the modelling work under the Safire project planning and monitoring unit
It would be useful to keep in touch and get support from the Miombo group especially Mandy, Herry and Jasper (Simile language).

Frank: Household time allocation for different options and strategies. With ACM team, Zimbabwe. Hopefully with support from Mandy but learning from other people's models like Muyeye, Kwesha, Sola, and Herry. Timeframe: paper by end of year -> Collection of data and write up.

Richard: Objective: Make the process more participatory by involving local people. Use the model as a learning tool, something that can assist local people to improve their livelihoods, and how they can influence policy so that it meets their needs. Not particularly interested in the complex stuff, ie: equations etc. But more on how the model can be used by local people.

Herry: Objective: to develop a DSS model for ACM sites in Kalimantan (& Jambi). With Stepi, Sonya, Ati and Dani and other interested persons (ie: Ravi, Frank, Happyson etc). Get support from Edinburgh guys. Over what period: this year (2001). First callibrated in May/June 2001.

Wavell: Period: 12 months. Objective: Moe away from econometric models to NTFP model in SIMILE. But it cannot be developed in isolation. Sub-NTFP group in the whole FLAC-group. How. Library shopping.

Maxwell: NTFP I will first put my ideas I have on paper into a SIMILE framework. Then I will team up with the NTFP group and see how I can formulate the equations. Duration – in about 1 year.

Muyeye: Modelling linkages between urban energy consumption and the environment. Within the overall 'urban fuelwood consumption economics' research project and within the context of WWFs miombo project. With Zimflores group, Kuda and FLORES technical team. Over next 12 months.

Happyson: Model development of Mafungautsi with the ACM group at CIFOR. Shall move into data gathering and standardising (calibrating). the whole Mafungautsi model. Then taking the model to the villagers for testing. All in not more than 18 months.

Kuda: Modelling habitat change in Campfire districts in Zimbabwe within a WWF project (18 months). To work with Muyeye and Happyson + technical support from Jasper.

Tendai: Put more emphasis on working with community to calibrate the Mafungautsi model so that it comes as close to reality as possible- other objectives identical to Richard.

Appendix 1:
FLAC Workshop 3 : Programme

22-26 January 2001. Harare, Zimbabwe.

Day 1:

0830 Discussion of proposed programme and logistics [15 mins]
Introductory round on hopes and expectations for the workshop [15 mins]
Discussion about sharing and protecting intellectual property [30 mins]
Refresher tutorial on FLAC and SIMILE [1hr]

1115 Update on new features in the latest SIMILE version [30mins]
The FLORES framework model [1hr]

1400 Tutorial on the equation language [1hr]
Tutorial on relations [30 mins]

1545 The modelling process [1hr]

Day 2:

0830 Presentations by participants on their modelling work
Presentation structure: model purpose/expected behaviour/conceptual diagram/model run results/problems/next steps/workshop targets [up to 2 hrs]
Discussion if time

1115 Expected model behaviour of models
Targets for the work of modelling teams during days 3 and 4 [1 hr]

1330 Data and GIS issues [1 hr]
First session on plans for the future [1 hr]
Review of progress against expectations [15 mins]
Discussion about a paper [30 mins]

Days 3 & 4:

The focus will be on implementing/modifying models and generating and testing model behaviour, participants working in 5 or 6 small teams. All teams will begin with their (hopefully black) model or a submodel from the FLAC library.

First, participants will explicitly compare and relate each team's model with the FLAC framework model (using post-its on a big poster of the framework model).
[90 mins]

Then, each team will work on their model, regularly running and testing behaviour. The team's tasks will include:

- modifying their model
- running and assessing model behaviour
- doing a variety of types of tests, with real data
- plugging and playing with submodels
- making plans for further testing

[This session will take most of the remainder of days 3 and 4]

Mandy and Jasper will help out, watch for common problems and issues arising, periodically interrupting everyone to point these out, to help people with reflection and sharing insights, to provide 'cheat sheets' and to move people on.
Jasper and Mandy should assemble a collection of start-point, interim and final models as the workshop progresses

At the end of the afternoon on day 4 teams will prepare presentations and draft reports of modelling progress.

Day 5:

0830	Presentations of progress with the modelling work [20 mins per group]
1100	Next steps and future planning : testing plans charting out plans for future modelling work identifying resource needs negotiations for sharing resources
1300	Workshop evaluation Any time remaining to be spent drafting reports, plans and a paper.
1600	Bus leaves for Harare

Appendix 2: Participants list

1. Chambwera Muyeye

World Wildlife Fund for Nature (WWF)
P.O. Box CY 1409
Causeway
Harare

Telephone 252 533
Fax 252534
E-mail: mchambwera@wwf.org.zw

2. Gambiza James

Tropical Resource Ecology Programme (TREP)
Department of Biological Sciences
University of Zimbabwe
P.O. Box MP167
Mount Pleasant
Harare

Tel 333 334
Fax 333 334
E-mail: gambiza@trep.co.zw

3. Gumbo Bekithemba

Department of Civil Engineering
University of Zimbabwe
P.O. Box MP167
Mount Pleasant
Harare

Tel: 303211 ext. 1484/1933
Fax: 303288
E-mail: bgumbo@eng.uz.ac.zw

4. Kowero Godwin

CIFOR Regional Office
Harare
E-mail: g.kowero@cgiar.org

5. Matose Frank

CIFOR Regional Office
Harare
E-mail: f.matose@cgiar.org

6. Mudavanhu Happyson

CIFOR Regional Office
Harare
E-mail: h.mudavanhu@cgiar.org

7. Mukwekwerere Maxwell

Forest Research Centre
Forestry Commission
P.O. Box HG595
Highlands
Harare

Tel: 496 878
Fax: 497 070
E-mail: frchig@internet.co.zw

8. Muhwandagara Kudakwashe

World Wildlife Fund for Nature
P.O. Box CY 1409
Causeway
Harare

Tel: 252533
Fax: 252534
E-mail: kmuhwa@wwf.org.zw

9. Mutimurefu Tendai

CIFOR Regional Office
Harare
E-mail: t.mutimurefu@cgiar.org

9. Nyirenda Richard

CIFOR Regional Office
Harare
E-mail: r.nyirenda@cgiar.org

10. Prabhu Ravi

CIFOR Regional Office
Harare
E-mail: r.prabhu@cgiar.org

11. Purnomo Herry

CIFOR Head Office
Indonesia
E-mail: h.purnomo@cgiar.org

12. Sola Phosiso

Southern Alliance For Indigenous Resources (SAFIRE)
10 Lawson Avenue
Milton Park
Harare

Tel: 795 461
Fax: 790 470
E-mail: sola@safire.co.zw

13. Standa-Gunda Wavell

CIFOR Regional Office
Harare
E-mail: w.standa@cgiar.org

Appendix 3: Target cheat sheet
What puzzle is your model addressing?

How does your model relate to the framework model?

Draw a graph of the target behaviour of a key variable

What are your targets for the next two days?

What activities will you do to meet these targets?

Appendix 4: Testing and planning cheat sheets

This chart is to help you start thinking about your data requirements for callibrating your model. List the parameters that your model requires in the first column. For each parameter put its value or range of possible values in the second column, and make a note of the source of the data in the third column. If you are estimating the values, write in the third column how you might get data to confirm them.

Parameters	Value(s)	Source of data

It is important to critique your model and this chart is intended to help you to do this. Thinking about the limits of your model and what you might do about them is an important step in planning how to modify a model. Think about the current limitations of the model and write them in the first column. For each limitation, is it legitimate given your purposes? (Put the answer to this in the second column). If not, decide what can be done to address the limitation and write it in the third column. Once the third column is complete, decide which limitation you will address first.

Limitation	**Legit?**	If not, what can be done about it?	Priority

Model testing crib sheet

Name of your model:

What model variable(s) behaviour are you interested in (test output)?

What variable will you vary (test input)?

How many tests with different values for this variable will you do?

Which values?

How many time steps will you run the model for?

Draw a graph, map or other diagram of the behaviour you expect to see.

What is your justification for expecting this behaviour? Does your graph come from empirical data? Is it your own judgement?

<u>Now do the tests</u>.

What behaviour did the model produce?

What differences are there between the expected and actual model behaviour?

How do you explain the differences?

What action can you take to find out if your explanation is correct?

Appendix 5: Paper outline

Help!

FLAC : a process of collaborative forest modelling in Zimbabwe

1. Introduction and background
    - FLORES
    - Miombo context
    - Who's involved in the process, research teams and organisations
2. The modelling process : iterative approach and workshops
3. SIMILE
4. The FLAC package : framework model, submodel library, manual,
5. The models developed in Zim
    - Mafungausi model
    - Muyeye's energy model
    - SAFIRE's model?
    - Kalimantan FLORES model?
6. Lessons learned and next steps

Appendix 6: SIMILE tricks

To get user support the best thing to do is to join the SIMILE email list, and send your queries and questions to the list so that everyone can benefit. To join, send an email to majordomo@lists.ed.ac.uk and put the following in the body of the message:
subscribe simile <youremailaddress@yourdomain>

A few useful tips:

1. Easy rows and columns for your model. Say you want 10 rows and 10 columns. Create a multiple instance submodel, with two dimensions. (ie: Create a submodel. Double-click in any blank space on the submodel, and you'll get a window saying 'Instances of Submodelname'. Make sure 'Generated Set' is selected and in the Dimensions field type 10,10.) Then create a variable called 'row' and in its equation window, double click on one of the dimensions in the 'Available Indexes' section in the lower half of the window. The result will be either index(1) or index(2) in the equation box. Create another variable called 'column' and for its equation double click the other dimension. Now each instance of your submodel will have its own unique row/column combination.

2. You can also do rows and columns with only one dimension. If you make 100 instances of a submodel (Generated Set, Dimensions=100), to generate a row number then use
floor((index(1) – 1)/10) +1
To generate its column use
index(1) – 10 + (row –1)

3. To make a variable give you the month (with each time unit representing one month):
floor(fmod(time(1), 12) + 1
(eg: at time step 56.3, this will be month 9. Why? Because time(1)=56.3, so fmod(time(1), 12)=8.3, so floor(fmod(time(1), 12)= 8 so month=8+1=9)

To make a variable give you the month (with each time unit representing one year):
floor((time(1) – floor(time(1)))*12)+1

4. Memory. Assume you have a boolean variable called fire (boolean means that it evaluates to either true or false). Then you can remember when there was last a fire by creating a variable called 'time of last fire' whose equation is:
if fire then time(1) else prev(1)

FLORES ZIMBABWE WORKING GROUP

1) Minutes of the first informal meeting held in the CIFOR Boardroom on Friday 30 June 2000 at 1400hrs

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PRESENT:	M. Chambwera	G. Gambiza	G. Kowero
	D. Kwesha	F. Matose	H. Mudavanhu (Recorder)
	A. Mushaka	R. Prabhu (Chair)	P. Sola

APOLOGIES:	I. Bond	D. Cumming	E. Hachileka
	M. Kokwe		

1. Adoption of Agenda

The proposed agenda was adopted.

2. FLORES Gwai and post- Gwai workshop

The chair summarised the outcome of the Gwai workshop and the post-Gwai workshop. He also took the opportunity to explain what FLORES is and what it hopes to achieve. Some inputs on the workshops were also made by D. Kwesha and F. Matose. The chair also explained that Mafungautsi Forest area was chosen as the modelling site since a GIS database on the forest already existed. Work on the Mafungautsi project was reported to be about to begin. The chair also explained that CIFOR was in the process of recruiting personnel to work on the modelling of the forest.

3. September 2000 Workshop

The chair explained that the September workshop which shall be in the third week of September, was open to all persons working with SIMILE and not only those working on the Mafungautsi model. An example of a project being modelled using SIMILE was given by H. Mudavanhu. Participants at the meeting were invited to come up with projects that could be modelled using SIMILE. PowerSimulation, a modelling package also being used in the Gokwe area was explained by G. Kowero.

4. FLORES support package

A CD-Rom with the FLORES/SIMILE package was reported to be available from CIFOR for copying. Also, background information on the Mafungautsi forest was requested and this was to be supplied in the form of the PRA report.

5. Next Meeting

It was agreed that the next informal meeting would be held on 28 July at 1400hrs in the CIFOR Regional Office Boardroom.

2) Minutes of the second informal meeting held in the CIFOR Boardroom on Friday 28 July 2000 at 1400hrs

PRESENT: Mudavanhu, H.T. Standa-Gunda, W. Nyirenda, R. Prabhu, R. Tsvuura, Z.

APOLOGIES: Lynam, T. Frost, P. Chambwera, M. Gambiza, J. Mushaka, A. Kwesha, D.

1. Adoption of Agenda

The proposed agenda was adopted.

2. Reading of Minutes of previous meeting

Minutes of the first informal meeting were read and passed as a correct record.

3. *A Simile model of a Buffalo (*Syncerus caffer *Sparrman) population in Mana Pools National Park, Zambezi Valley*.

This presentation was made by Zivanai Tsvuura and is part of his ecological studies. A summary of the research and the model is attached below.

4. Update on the September workshop

Ravi gave an update of the September Flores workshop and announced the workshop dates as 19-21 September 2000. A request to know the number of persons interested in participating in the workshop was made.

5. Next Meeting

It was agreed that the next informal meeting was to be held on the 18th of August 2000.

3) Minutes of the third informal meeting held in the CIFOR Boardroom on Friday 18 August at 1400hrs

PRESENT: Aggrey, A. Ayuk, E. Chambwera, M. Cumming, D. Gambiza, J. Kokwe, M. Kwesha, D. Mapedza, E. Mudavanhu, H. Nyirenda, R. Prabhu, R. Standa-Gunda, W. Tsvuura, Z., Zinhumwe, C.

APOLOGIES: Frost, P. Lynam, T.

6. Adoption of Agenda

The proposed agenda was adopted.

7. Reading of Minutes of previous meeting

Minutes of the first informal meeting were read and passed as a correct record.

8. A simulation model of miombo woodland dynamics under different management regimes.

This presentation by James Gambiza was prepared using the Stella modeling software. A copy of a publication proceeding from this research was made available to the meeting participants.

9. Update on the September workshop

Ravi Prabhu gave an update of the September Flores workshop and announced the workshop dates as 19-21 September 2000. Copies of the SIMILE programme Manual and User's Guide were distributed to the participants. Also the six points raised by Robert Muetzelfeldt were discussed and it was agreed that participants would bring back their full responses by Friday the 25th of August.

10. Next Meeting

It was agreed that the next informal meeting was to be held on the 12th of September 2000.

4) Minutes of the 1st FLORES Zimbabwe Group Informal Meeting on Modeling Decision – Making, 17 October 2000, TREP Seminar Room, University of Zimbabwe.

PRESENT: Chambwera, M., Frost, P., Gambiza, J., Gondo, P., Kwesha, D., Mapedza, E., Matose, F., Mudavanhu, H., Mukwekwerere, M., Prabhu, R., Tsvuura, Z.

INTRODUCTION

The meeting was chaired by Ravi Prabhu and he introduced the purpose of the informal meeting with reference to the forthcoming workshop on modeling decision making. He outlined that the purpose of the meeting was to prepare the FLORES Zimbabwe group for the workshop and also to gather the needs of the said group with respect to the model's content.

ADOPTION OF AGENDA

The proposed agenda was agreed to and adopted for the meeting.

SOME COMMENTS

Some comments were made with regards to the notes sent by Robert Muetzelfeldt concerning the proposed agenda of the meeting. Peter Frost commented that the notes were very insightful as they highlighted the difference between "Types" of decisions and "Specific decisions". He added that 'types' of decisions were much more generic than 'specific' decisions. Peter also commented that the Zimbabwe group needed to cut down on the numbers of decisions and the types of decisions inorder to progress, although these were to be done according to what uses were going to be made of the model developed thereof.

GROUPS OF DECISIONS

All meeting participants contributed to the groups of decisions that were expected to be made using the model. These are summarized as follows:

1. Crop Production

- Types of crops (Species and Varieties)
- When to plant (Year to plant. Time of year to plant (season). Time into a given season to plant e.g. plant with early, mid or late rains)
- Area of land to be allocated to (a) all crop cultivation (b) specific crop cultivation

2. Animal Husbandry

- Types of animals to keep
- Number of livestock (total number and numbers of each species) to keep
- Number of animals to sell and or purchase
- Where to graze livestock

3. Time Allocation to Woodland Product Collection

- Collection of firewood
- Harvesting non-timber forest products
- Harvesting woodland products

4. Marketing (produce/products)

- When to sell
- Where to sell
- How much/many to sell

5. Household Economics

- Household expenditure - On What
  - How much
  - When
- Types and Numbers of houses to construct
- Investment as opposed to pure expenditure

6. Food Consumption

7. Land Clearance

Whether or not to clear more land for cultivation

- Where
- When
- How much

8. Labor allocation

- How
- Time to allocate to non-agricultural activities
- Time to allocate to agricultural activities

9. Improving Human Capital/Welfare/Family Health and Reproduction

- Family size
- Which children to send to send to school
- Choice of school to send children

10. Types of Things/Products to Access

- Replacement of thatching
- Where to source firewood
- Timber for fencing (amount and size)

11. Social Networking

- Political Affiliation
- Membership of Religious Group
- Other Organisations (e.g. clubs)

12. Outsourcing

- Decision on when to hire out livestock to other households e.g. draughtpower

13. Land Tenure/Holding

- Family annexing land in anticipation of sons getting married and requiring land for their own families

14. Non- Agricultural Income Sources

- Decision on whether or not to devote time to moulding bricks for sale, building other people's houses for a fee, etc

After a brief review of the major decisions that had been submitted by participants, a few other decisions were added and these are listed below.

It was generally agreed to that:

a) Decisions exist within causal chains (decisions are linked)
b) Decisions at one level are influenced by decisions made at higher levels (constraint opportunities)

Some of the major decisions that were added onto the list after a brief review are:

15.Strategic Access to Information

16. Resource Management

17. Risk Spreading

18. Out-migration

19. Leisure (such as visiting a relative)

5) Minutes of the FLORES Zimbabwe 2nd Informal Meeting on Modeling Decision Making, 31 October 2000, University of Zimbabwe

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PRESENT

Chambwera, M., Gambiza, J., Kamumvuri, G., Mudavanhu, H., Mukwekwerere, M., Nyirenda, R., Prabhu, R., Standa-Gunda, W., Tsvuura, Z.

APOLOGIES

Ayuk, E., Frost, P., Gondo, P., Kwesha, D., Mapedza, E., Matose, M.

AGENDA

The proposed agenda for the meeting was adopted

READING OF MINUTES

The minutes of the previous meeting were accepted as a correct record.

A. RESPONSES TO SOME OF THE POINTS RAISED BY MANDY

1. Is the list of groups of decisions already in some order of priority?

See item B below

2. Could point 3 and point 8 be combined (time and labour allocation)?

It was generally agreed to that time and labour allocation cannot be combined, as some activities such as 'Leisure' are not commonly viewed as 'Labor' activities.

3. Could 2 and 12 (animal husbandry and hiring out draught-power) be combined?

No. 'Hiring out of draught-power' was given as just one example of 'Outsourcing'. The example could equally have been Income from Grinding Mill, or hiring out of plough or scotch-cart.

4. Are 7 (land clearance) and 13 (land tenure) linked?

There certainly is a link, but this differs depending on which end you are looking from. People clear land for reasons that are different from tenure.
One could ask: *What is driving Land Clearance?* and the most common answer would be: High pressure for cultivating land.

One could also ask: *What is the precondition for land clearance?* And the answers here could be varied. It could be that people clear land because it lies in the 'Commons' (Communal Land) and had not been allocated a particular household. Or it could be land that the household had claims to (tenure rights over) but had been setting aside until such a time when there was a need for more land, e.g. When the sons grow up and need own land.

It was felt that this question would warrant some discussion at the workshop.

5. Conversely perhaps it would be useful to separate out item 10 into: what resources are needed and where to do activities.

Yes it was strongly agreed to that it would be important to address the WHERE question.

8. What are the levels that you refer to in point (b) near the end 'Decisions at one level are influenced by decisions made at higher levels'?

District Level Decision Making

B. PRIORITIZING HOUSEHOLD DECISIONS

Participants were asked to prioritize the decisions made at the household level by selecting the three most important. The scores are shown below.

DECISION	PRIORITY SCORE (N = 9)
Crop Production	7
Animal Husbandry	5
Household Economics	3
Labour Allocation	3
Time Allocation to Woodland Product Collection	2
Human Capital Improvement	2
Land Tenure/Holding	2
Marketing	1
Food Consumption	1
Land Clearance	1

C. DISTRICT LEVEL DECISION MAKING GROUPS

The generic decision making groups at the District levels were listed and prioritized by the participants. These are shown in the table below.

DECISION MAKING GROUP	PRIORITY SCORE	
Local Government (District Admin./R.D.C.)	6	
Extension (AGRITEX/NRB)		6
Village Leadership		4
Political Leadership		4
Forestry Commission		3
NGOs		1
Private Sector Companies	0	
Growth Points		0
Farmers' Union	0	
Economic Groups/Clubs	0	
Veterinary Services		0
Local Traditional Leadership		0
Religious Groups	0	

D. DISTRICT LEVEL DECISIONS

1. Decisions made by Village Leadership (not in order of priority)

Land Allocation
Gate-keeper role for information, ideas and initiatives
Influence land-use decisions
Resource allocation
Calling of Village Meetings
In-migration
Infrustructural development – where a village borehole, or garden etc is to be cited
Conflict management

2. Decisions made by Extension (Forestry Commission, Agritex, NGOs, Private Companies, Veterinary Services, Economic Groups, etc)

Types of crops to be grown
Marketing of produce
Harvesting of resources – when, what, where, who, how
Soil and water conservation
Animal husbandry
Crop husbandry
Advising on development of by-laws

3. Decisions made by Local Government/Political Leadership

Where to put up infrastructure e.g. roads, clinics, dip-tanks, dams, etc
Land allocation
Utilisation of communal resources
Enacting by-laws – which, when
Influence where to settle
Share of income, levies, taxes
Gate-keeper role to info, ideas, initiatives

- It is apparent that decisions made by Village Leadership and by Local Government/Political Leadership were similar. There only difference was that these decisions were made at a broader scale by the Local Gvt./Political Leadership.
- The next stage in this analysis would be to envisage how these decisions made at District level would impact(affect) on the local (household) level. Because of time constraints this could not be done at the meeting. It was proposed that this be the first item after a recap on the proceedings of the informal meeting, on Day 1 of the Workshop.

E. REVISION OF THE DRAFT WORKSHOP SCHEDULE

Points that were added into the draft schedule by the participants are italicized.

Day 1 am
Welcome and introductions
Recap previous workshop outcomes
Review of work since previous workshop
Reports from meetings on modelling decision-making
Aims for this workshop
Recap of FLAC/SIMILE

Day 1 pm
Continue with Decision Making Framework. The WHERE question

Day 2 am
Exploration (hands-on) of some options for the 'left-hand-side' of the
model, ie: people, in the FLAC framework

Day 2 pm
Local modelling work - demonstrations and problem-solving
Design of people submodel of FLOREZ
Understanding what adaptations of the FLAC framework model are essential for
the miombo context.
Analysis of whether these adaptations need low, medium or high power
machinery (low=users can do it now, medium=experts can do it now, high=need more
development)
Presentation of models developed by participants
Begin building the low powered model components, specifying the medium
powered components and listing the high powered components

Day 3
More work on models and specifications
Develop plans for follow-up action by participants
Write requests to the Edinburgh team for assistance and other FLAC support
Evaluate workshop
Scope the next workshop

Record of the FLAC evaluation week 19th – 23rd February, 2001

Fergus Sinclair

The purpose of this evaluation was twofold. Firstly, to evaluate the usefulness of the Flores Local Adaptation and Calibration (FLAC) process and materials for building local capacity in developing models in Zimbabwe, and secondly, to assess the usefulness of this activity in terms of influencing policy affecting the miombo woodland resource. Initially, policy makers had been envisaged as a different set of clients from the organisations engaged in the modelling activity, however, analysis of the policy making process at the inception workshop (see report above) concluded that the key requirement was for these organisations to achieve participation from a range of stakeholders in developing models that could be used to explore the consequences of different policy options.

The evaluation week consisted of individual visits to the various organisations that had participated in the FLAC project, discussions with the ACM group at CIFOR who had developed the Mafungautsi model and a final meeting with some members of the international FLORES group to discuss progress and ways forward. It is documented here as reports from each of the visits followed by a set of overall conclusions that also incorporates information from the earlier workshop records. The evaluation was organized by Fergus Sinclair from Bangor and interviews were conducted and reported by him except for those with the Forestry Commission and Botanic Garden which were conducted by Jerry Vanclay and that with Tim Lynham at the University of Zimbabwe which was conducted by Robert Muetzelfeldt.

World Wildlife Fund (WWF)

The evaluation with WWF involved two phases. Firstly, a detailed discussion with Muyeye Chambwera about his experience of the FLAC process and the specific modelling activity that he has undertaken. Secondly, a broader ranging meeting was held with David Cumming, Ivan Bond and Muyeye to discuss the policy implications of the modelling work within the organisation.

Modelling activity and FLAC

Muyeye's interest in developing simulation models was to enable him to analyse interactions between economic activities and the environment. Specifically, he had used Simile to develop a model to explore impacts of pricing on urban demand for fuelwood and hence the impact on the environment. This is part of the WWF miombo conservation project, so the environmental focus is the miombo woodland around urban centers.

Muyeye has made the model the key vehicle for obtaining and presenting results of the work in progress. His initial geographic focus was Harare, with intentions to broaden the study to parts of Zambia and Mozambique. There are regional differences in fuelwood use that alter relationships, for example while fuelwood is generally consumed directly in Zimbabwe it is more commonly converted to charcoal for transportation to urban centers in Zambia. A major concern in Zimbabwe was how anticipated shortages of foreign exchange at a national level might lead to high prices and problems in availability of alternative fuel sources (kerosene and electricity) and hence an impact on woodland as more wood was used as fuel. The model consisted of households, that consumed different forms of energy depending on their price and availability. The woodland resource was modelled as radial belts (annuli) at different distances from the urban center. Price of fuelwood was calculated as a combination of stumpage and transport costs. People decided upon which type of energy to use based upon the cheapest option, including the costs of investing in an appropriate stove and/or electricity connection if they were switching from one source to another. Fuel prices could be subsidized and kerosene and electricity prices were sensitive to the availability of foreign exchange.

Muyeye had clearly developed sufficient modelling capability to implement a model in the course of his work and thought that this activity had been useful in several respects. Firstly, it produced dynamic and visible results important in the way WWF works because it was easier to present results to his colleagues. Developing the model had helped him to organise the information and understanding that he already had about the problem and to identify key requirements to understand it better. This had resulted in changes to his survey design and data collection. So while he already had data on what appliances people have (household data on ownership of different types of stoves and access to electricity) he needed to collect new information on why people swap from using one fuel to another, he also needed to collect initial biomass availability in different woodland zones, pricing of firewood in different zones (including price of transport) and land ownership. Using a model to synthesise understanding and data from the outset, gave him a framework for interacting with local stakeholders as the project unfolded and for collating information and presenting and exploring its consequences as data were collected.

Muyeye developed his model from scratch rather than using a FLORES template. The model structure is simpler than one that would be developed from a FLORES skeleton in that it has a single timestep (one year), no nesting of human actors within larger social structures (such as villages) and fairly gross representation of the landscape, only as a series of woodland bands around a city rather than a complete patchwork of landuses. The model does, however, comprise interaction between people and natural resources at a landscape scale with some explicit representation of decision making by people and it was obviously well suited to his purpose. This has implications for whether FLORES models should be defined at specific spatial and temporal scales.

Muyeye was clearly able to use the Simile modelling environment and the FLAC documentation to achieve his own modelling objectives. He felt the major limitation to model development was his awareness of theory for relating prices, income and consumption. He had, therefore, found developing and realising appropriate relationships amongst components in the model most difficult. Things had improved with the introduction of on-line help describing the functions in the equation dialogue but more examples of how to model particular types of situation would have been helpful as part of the FLAC package. While it was clear that the modelling activity had impacted upon the way in which WWF was addressing policy issues surrounding fuelwood use in a miombo context, it was too early in this process to evaluate whether this would precipitate change in policy decisions.

Muyeye has plans to broaden the model for the whole miombo region, he is confident of continuing to work with what he has done but would value continued support from experienced Simile users (preferably in Zimbabwe) in the course of developing new aspects. He has already shown Simile to two other colleagues within WWF and feels that a critical mass of people involved in modelling within the organisation would make it easier to realise the benefits of incorporating a modelling framework within his work. This seems possible but would require institutional investment in capacity building. He now is to some extent ‘tied in’ to a continuing use of Simile since he has invested in learning how to use the environment and in the model development.

Models and meeting WWF’s future agenda

In the broader discussion of WWF’s needs and the role of models and modelling within this, it became clear that developing tools for exploring long term consequences of short range decisions about land use change, was central to their activity. A need to build a participatory modelling framework into project activity had been recognised and resources could be committed to achieving this. There was a clear need to model at a range of scales to encompass decisions made at different levels and to encompass broader land use issues in addition to conservation (small efforts were considered unsustainable in achieving long term conservation). WWF are now working with an ecoregional conservation approach. With respect to miombo, there is a Global 200 site for miombo habitat, making this a key conservation priority for WWF. This is a large area of habitat straddling Mozambique (Niassa game reserve) and Tanzania (Selous game reserve). The key focus in this area is the interaction between subsistence agriculture and conservation. Several scales are significant:

- *transnational*, encompassing the entire area of reserve and buffer (100 000 km^2) across two countries within a regional policy context
- *landscape*, encompassing specific activity at the forest margin in terms of how people and their agricultural intensification affects the woodland habitat, this will differ in different parts of the reserve area, where conservation threats and agricultural opportunities differ, within a local governance policy context, and
- *household*, encompassing livelihood opportunities, particularly for the most vulnerable people living within a resource use context of the habitat, within both a national and local policy context.

The other major activity within the miombo context, is the fuelwood and charcoal work that Muyeye has already described. This has a strong poverty alleviation focus with respect to charcoal use in the copperbelt in Zambia where collaboration with the private sector (AngloAmerican) is important given the declining ability of governments to effect change in resource use.

WWF are interested in participating in further development of a FLORES approach within a miombo context and of associating their ongoing project activity with this. WWF see visualisation from participatory models as a powerful tool to influence policy makers in government, private corporations, the NGO sector and amongst local communities. The modelling activity facilitates inter-disciplinary and inter-institutional collaboration, but technical support may be required to facilitate participation. Realising this sort of collaboration is important for achieving transboundary natural resource management.

SAFIRE

The evaluation with Southern Alliance For Indigenous Resources (SAFIRE) also involved two phases. Firstly, a detailed discussion with Ms Sola Phosiso about her experience of the FLAC process and the specific modelling activity that she has undertaken. Secondly, a broader ranging meeting was held with Peter Gondo to discuss the policy implications of the modelling work within the organisation.

Modelling activity and FLAC

Sola joined the FLAC process fairly late on at the third and final workshop prior to the current evaluation (only about a month ago). She has, however, made quick progress in implementing a model within her work programme. Her aim is to use a model to investigate the impact of commercialisation of miombo resources (such as processing and sale of fruit of *Sclerocarya birrea*) on resource status (standing stock) and peoples' livelihoods that are depending on the resource (income). She hopes to use the model as a tool for project planning and impact evaluation within the SAFIRE MITI project. Prior to project implementation, she intends to use baseline data to predict the potential impact of resource extraction on community income and resource status. This will be done so as to develop, test and evaluate management strategies to mitigate the impacts. During the project life, the model will be periodically used to predict the potential impacts of recommended extraction rates (harvesting: techniques, volumes, frequency) using the resource performance attributes measured in the field as the project progresses (standing stock, recruitment rates, mortality and growth rates).

The model consists of three main submodels namely 1) the community, 2) markets and technology and 3) the resource base. The community is currently represented as a single population in the submodel, rather than being disaggregated into villages and households. Equitability (distribution of benefits) as well as their size is a desired output which may require disaggregation but key decision making on quotas and other regulation and management of the resource occurs at the community level. Income submodels for crops, livestock, timber, NTFPs and other livelihood strategies are under development.

Sola has found Simile a very useful and user friendly environment, previously she had found modelling difficult, but simile allows her to add variables easily so that she can construct a model by taking what she finds at a grass roots level and represent this in her model. She wants to take the model back to the community and run it together with them so that they can explore what happens to sustainability of resources if different extraction quotas are observed. She thinks that this will help the community to understand impacts of commercialisation on the resource base and project planners to explore effects of microfinancing and technological change. She is also keen to explore alternative scenarios where 1) income generation leads to people re-investing in their livelihood system or 2) behaving otherwise, and then trying to understand what conditions need to be in place for positive re-investment to occur.

While she has been able to get on and begin implementing her model she is not able to use all of the facilities available in Simile yet. She does not understand all of the input/output tools or all of the functions that can be deployed in the equation dialogues. She attended one informal Simile session in addition to the workshop, but was not in a position at that stage to know what to ask and, therefore, is not sure how much support she will get from other Simile users in Zimbabwe although she anticipates that talking to some of the people with more experience of modelling social dimensions of resource management will be useful. She envisages that an opportunity to sit down with an experienced modeler at roughly three monthly intervals would be ideal. She is able to solve technical problems by consulting the on-line help and FLAC documentation or sending email queries to the FLORES team but is aware that there may be more fundamental ways in which her approach to problems could be improved if she had a periodic opportunity to interact with more experienced modellers, able to suggest approaches that she is not aware of. Other SAFIRE staff who had attended earlier FLAC workshops had found the process daunting and had not yet implemented their own models, although Sola thought that other staff would be interested in using a modelling approach when they saw what she had achieved. This led to a discussion of whether the FLAC workshops had involved models that were too complex for people with no previous modelling experience and whether the focus within FLORES on the landscape scale with disaggregated communities and land units was appropriate. Although Sola had implemented a less complex representation herself, she had found working with the more complex training model a useful exercise, mapping out possible ways of achieving things in the future. It was thought possible that cramming the workshops, often into less than a week, to accommodate participants' other commitments but nevertheless trying to work through an ambitious preset agenda, may have put very heavy demands on participants with little or no previous experience.

Modelling in the context of meeting SAFIRE's future agenda

Peter Gondo felt that much of SAFIRE's current activity fitted well with the FLORES concept. His current focus is on commercialization of non timber forest products in five districts in the northeast of Zimbabwe. This is a dryland in agroecosystems 4 and 5 with low yields and impacts from rising population caused by refugee movement into the area. There is a high dependence of livelihoods on natural resources and acute need to raise rural income. Their approach presently involves encouraging development of processing and packaging enterprises coupled with institutional development within communities to enhance management capability of both co-operative processing and marketing ventures and the resources upon which they are based. A key requirement is to find and negotiate sustainable off-take rates as the basis for resource management, and he sees modelling as a useful tool to achieve this. They had spent time at the FLAC workshops on modelling socio-economic components and now had developed a simple model of impacts of commercialization. The present requirement was to collect data and test the model. They have initially been more interested in aggregated community models because that is the level at which decisions are made about woodland resource management in village resource committees. He envisaged some constraints to using models as a central feature of work within SAFIRE. Many staff had a fear that modelling was very difficult and there was a need for institutional investment in training. A potential problem was that staff on the research and development side were much more inclined towards modelling than field staff and such lopsided participation may lead to unhealthy bias in model development and ownership. This was, however, a challenge rather than a blockage. SAFIRE's thrust is now to go beyond identifying what needs to be done to actually doing it – and visualizations of the consequences of different resource management strategies could help communities make decisions. Also, although miombo is a diverse habitat, particular communities may, in fact, rely heavily on one species or commodity making them vulnerable but also making understanding and modelling their resource use more tractable. SAFIRE are in the process of narrowing the target range of miombo products initially from 20 to 14 and they anticipate five or six priorities for commercialization to emerge, focusing on indigenous fruits and essential oils.

CIFOR – Adaptive Collaborative Management

Much of the experience of the ACM group in developing the Mafungautsi model is recorded in the records of the FLAC workshops and the model specification included earlier in this report and will not be repeated here. Some indicative model output appears in the FLAC manual (pp 153-159) and the model itself is included on the compact disc supplied with the manual (both the manual and model are also available from the website). Although the model development involved people from several institutions, the discussions reported here were with members of the ACM team working directly at CIFOR (principally: Happyson Mudavanhu, Frank Matose and Ravi Prabhu).

Local People, Devolution and Adaptive Collaborative Management (ACM) of Forests, is a project led by CIFOR, seeking to understand how human well being and forest resource quality are impacted by processes of collective action, communication and learning, and collaboration and conflict between forest stakeholders. The geographic focus of the modelling activity centers around the Mafungautsi state forest in Gokwe district of Zimbabwe and the people living in its vicinity. The purpose of the FLORES model is to simulate the impact on local people's livelihoods and on the miombo woodland resources, of processes of communication, collaboration and social learning in response to changes in resource access regulations and other policy interventions.

So far the process of modelling has been as important to the ACM team as the model itself – although they thought that this balance may change as the resulting model is increasingly used to explore the possible consequences of change, as opposed to being developed as a framework for understanding key causes and effects. The process has fostered interdisciplinary team work and the process has been useful in generating new insights and clarifying key relationships between problems and their causes.

The critical importance of the FLORES approach has been in making the process of model development participatory. This is allowing practitioners from various disciplines rather than full time modellers to develop the model. The assistance of mentors (Mandy Haggith and others during workshops) has been important in facilitating this process but it is clear that the Simile environment and FLAC documentation have been effective in enabling people to organise information and implement their understanding of natural resource management issues in contributing to a functional simulation model at a landscape scale (encompassing several villages at a forest margin and a land area of several square kilometers).

The various stakeholders in the ACM work now have a pretty clear understanding of what a FLORES type model might do for them, and what it will not do. The model is not expected to solve complex rural development problems, but through the process of developing the model and then using it to explore alternative options, the team are able to contribute towards making complex problems more tractable and promote more informed discussions about alternative scenarios. It is anticipated that this will lead to improved choices and policy decisions further down the line.

The ACM team have secured continued funding for a further year's FLORES activity, during which time they aim to deliver a tested and validated model of the people-forest interactions for the three villages they have selected in the Mafungautsi area. The model will then be used to gain insights into and influence management processes and outcomes.

Forestry Commission

The Forestry Commisssion (FC) are involved in the ACM developments in Mafungautsi (reported under CIFOR above) as well as having a broader interest in the use of modelling in forest development. This is a report of a meeting in which Jerry Vanclay discussed issues mainly with Maxwell Mukwekwerere.

The FC feel that they have a fair knowledge of systems modelling and Simile in particular, but lack confidence with the equation dialogue box used to put equations into models. They are interested in using FLORES-type models to investigate the contribution of NTFPs to household needs (especially the contribution of woodcarving and forest fruits to household food security). They also anticipate using modelling to explore the balance between cropping versus gathering, with a view to trying to shift the balance. Modelling of forest growth is already well covered.

They appreciated their involvement in the workshops, and specially liked the presentations on the Sumatra model. They would have liked to experiment more with Simile, but had been diverted by demands of the Catchment Rehabilitation project. They had not initially envisaged much scope for modelling in that project, because they have mainly qualitative data, and at present that relates mainly to indigenous fruit trees. They are currently spending lots of time in the field doing surveys for catchment rehabilitation work, so have little time for modelling, although they did see scope to use it to assess the effectiveness of rehabilitaiton and its effects on households. Ironically, more time modelling at the outset might change the data they think they need to collect. There was some debate about the most effective form of rehabilitation. GTZ and NORAD wanted to fence areas and replant them, but the Department of Natural Resources wanted to fence and allow natural regeneration. Overgrazing seems to be the major cause of degradation addressed by the rehabilitation work - and this is exacerbated by the popuation density.

There was potential to use models to come to grips with issues in communal areas, and the FC saw a place for FLORES-type models there, especially in resolving issues surrounding minor forest products

- but there still remains major issues in finding ways to quantify them. Illegal settlers within forest areas were previously evicted, but
are now condoned, even in areas where there are no formal resettlement projects.
Many squatters were previously recruited as forest workers, but no longer.
They, like many formal resettlers have no cash, no schools, no community and no implements, so they harvest and sell fuelwood for cash.

Botanic Garden and Herbarium

Based on a discussion that Jerry Vanclay had with Gideon Kamumvuri.

The botanic Gardens anticipates big changes in vegetation patterns in Zimbabwe during the next two years as a result of resettlement programs, threatening several CITES-listed plant species. They see a need to monitor these changes, and update species distribution maps, but also a need to be more proactive. They would like to use a FLORES approach to explore alternative conservation strategies. Uncontrolled fuelwood harvesting is a major threat to much vegetation. Aquatic flora is also threatened as a consequence of resettlement because of likely siltation of dams and streams. Many settlers are not experienced farmers and may be unfamiliar with their new locality and be short of capital for purchase of implements, which is likely to result in unsustainable practices and ecosystem degradation.

Gideon's current responsibility is the indigenous medicinal plants project. He sees a role to use the FLORES approach to explore socio-economic aspects to complement his work on systematics and ecology of these plants. But, he has limited access to computers, exacerbated by staff shortage reducing time availability, that has hampered his ability to use Simile and the FLORES approach in pursuing his objectives over the past six months.

ICRAF (International Center for Research in Agroforestry)

Based on a group discussion with Freddie Kwesiga (Regional Director), Elias Ayuk (Country Director) and Aggrey Agumya (GIS specialist).

Both Aggrey and Elias have attended a few elements of the FLAC process but neither were able to do so comprehensively. They see a relevance to their work at ICRAF, particularly Aggrey with respect to spatially explicit modelling. The recent advances in data transfer incorporated in the latest version of Simile, make it more attractive as a tool to interface with GIS. ICRAF would be interested in collaborating on a regional initiative to develop tools for decision support in joint resource management of miombo woodland. They have a number of specific areas of activity in this respect: marketing, tenure and access of indigenous fruit trees; germplasm evaluation and development of key miombo tree species with commercial potential; understanding and evaluating relationships between farming and encroachment; and landscape level planning and evaluation of woodland resources and their environmental impacts, especially in a watershed context. Policy and governance issues are critical in relation to miombo and a large regional project could make a difference if tied in with awareness campaigns at national and regional levels.

University of Zimbabwe (Institute of Environmental Science)

Based on a series of discussions with Peter Frost

Peter is acting generally as an independent consultant and has used a wide range of models and modelling approaches in his recent work. He has a particular interest in how science can influence the policy process (some of his ideas were important in steering the nature of the FLAC process at the inception workshop – see report above). While he had attended the FLORES workshop in Gwai, co-chaired the FLAC inception workshop and participated in the first two FLAC training and model development workshops he had been unable to attend the final FLAC workshop. He saw the major value of FLORES being the ease with which models could be developed using the FLAC approach and materials. He felt that initially the software and documentation were not straight forward enough but was impressed with the latest release of Simile that handled data input from files more easily and incorporated an effective on-line help feature that made it easier to see how to implement ideas while 'on the job' and provided ready access to an explanation of the functions available in the equation dialogue box. He was also impressed with the newer spatial displays, such as the polygon helper (that displays land use change as a map of patch attributes) and sees further development of input and output tools for spatially explicit representation of both input scenarios and consequent outputs as important.

Based on a discussion that Robert Muetzelfeldt had with Tim Lynam

Tim Lynam is involved in a project, funded by the DFID Livestock Production programme, which aims to enhance local capacity for the management of Common Pool Resources. The target community is in the Muhuwe ward in the East Zambesi valley. The management objectives, arrived at through a process of consultation with local people, include restricting the number of people in the area to carrying capacity (by limiting immigration), keeping the number of livestock at carrying capacity, and landuse planning. The main focus is on livestock, and one of the key issues is the conversion of land from one use to another, and the allocation of land to grazing.

Tim has used compartment-flow diagramming as a way of encouraging local people to express their views on the key processes operating within the system, leading on to the development of simulation models that can then be used, with the local people, to explore possible scenarios. Most compartments relate to the area under different forms of land use, and flows between compartments represent the conversion of land from one use to another. The basic diagrams were produced by the people themselves, on flipcharts. Tim then used these diagrams to construct a model in the Simile visual modelling environment, using simple relationships for the rate of conversion between landuses.

This approach represents an interesting alternative to typical FLORES modelling, which normally addresses changes of biophysical attributes within areas (e.g. forest growth), or the change of a patch from one landuse to another (e.g. clearing of a forest patch for cultivation). It also says much for the intuitiveness of the compartment-flow language, that it can be used in a community setting by people with little formal education, let alone training in compartment-flow modelling.

Tim is also developing fine-grained models of the above areas, using an object-oriented approach in Java to model at the level of households, patches of land, and livestock herds. This corresponds more closely to FLORES modelling, and there is potential here to compare the relative merits of alternative approaches.

He is also involved, or becoming involved, in a number of projects which potentially relate to FLORES/Simile. These include:

- The development of a GIS-based spatial model for elephant management, including impacts of elephants and their management on biodiversity (with Will de Jong of CIFOR), and cost-benefit valuation of landscape.
- A number of Millennium Ecosystem Assessment study sites, in Mozambique, the Zambesi valley, Orange Water and the Okavango delta, with WRI as the link agency.
- A Resilience Alliance programme, concerned with the adaptive management of Natural Capital Systems in semi-arid Southern Africa, focussing on the South East Lowveld of Zimbabwe, and Gorongosa National Park, Southern Africa.

In all cases, there is a strong emphasis on sustainability and livelihoods, in addition to the more obvious conservation and biodiversity aspects. There is clearly considerable potential for the use of sophisticated modelling environments such as Simile, and for the integrated modelling of biophysical and human components, as in FLORES.

Applications in other countries

In addition to the use of a FLORES approach in Zimbabwe, directly supported by the present FRP-funded FLAC project, several other groups have adopted the approach and project outputs. These include forest margin initiatives in West Africa, Latin America and Indonesia.

A consortium led by IITA, are developing with local stakeholders, a model of people and resources at the forest margin within the Ecoregional Programme for the Humid and subhumid Tropical Africa (EPHTA), forest pockets benchmark in Southern Cameroon. This has connections to the CGIAR system wide Alternatives to Slash and Burn (ASB) programme. Chris Legg, who was involved in the original development of the FLORES model at Bukutingi and attended the first 'Gwai' FLORES workshop in Zimbabwe , has been appointed by IITA to lead the model development process. The present evaluation of the FLAC process in Zimbabwe was presented at a seminar given by Fergus Sinclair in IITA in Cameroon in March 2001 and several of the FLAC development team (including Robert Muetzelfeldt, Jasper Taylor, Mandy Haggith and Ravi Pravhu) attended an initial model development workshop in April 2001.

CATIE in Costa Rica are leading a consortium of conservation NGOs and farmer organisations in Nicaragua and Costa Rica with support from universities in the UK and Germany (funded by EU INCO-DC) to develop FLORES models to explore trade-offs between farm productivity and regional biodiversity in fragmented forest landscapes. The programme includes components on inventory of trees outside forests, acquisition of local knowledge and decision making criteria about tree cover from farmers, assessment of biodiversity at a range of scales and participatory model development and their use to support decision taking in both community (landscape) and regional policy contexts.

In Indonesia, Herry Purnomo, in the context of the CIFOR ACM programme, is leading development of a FLORES model to represent dynamic interactions between local people and the forest resources at the Gunning Lout Protection Forest, Passer District, East Kalimantan. This aims to improve understanding of how forest cover and human well-being is influenced by the interactions of local people and forest resources, and how forest product changes are influenced and impact upon this. Herry attended the final FLAC workshop in Zimbabwe (see report above).

Overall Evaluation

The nature of demand

There is clearly a widespread demand in the region for tools to assist in decision making about natural resource management issues at various levels from household and community group decisions about resource exploitation and regulation, through project planning in both government and non-governmental sectors, to national and regional policy. Uptake of the FLORES approach further afield in West Africa, Latin America and Indonesia is evidence of considerable demand for the sort of tools being developed in the FLORES initiative.

Development of locally relevant simulation models is considered a key element in achieving more sustainable use of miombo woodland in the context of rural livelihoods and environmental conservation. A range of organisations have been prepared to make institutional investments in developing capacity to implement models, using Simile and the FLAC materials, as a mainstream part of their work programmes (WWF, SAFIRE, TREP, the Forestry Commission in Zimbabwe and other stakeholders in the CIFOR ACM initiative). This is being done in a participatory context to address complex resource management issues where there are multiple stakeholders and objectives and hence a need to explore trade-offs and negotiate conflict.

These findings of widespread demand to use simulation modelling as an integrative tool in natural resource management, with explicit treatment of human as well as natural processes, is in marked contrast to concerns expressed by reviewers and FRP programme management regarding potential uptake of project outputs. There is a requirement to communicate the extent and nature of this demand to policy makers within DFID.

Complexity and participation

It is clear that a major motivation for using integrative tools is that people and institutions attempting to address complex resource management issues need help in addressing the complexity. The complexity arises both from the diversity of actors involved in resource exploitation and the diversity of the natural resource base, where there is often a heterogeneous mosaic of land uses. Negotiations regarding access to and exploitation of resources, require means of exploring the consequences of different possible courses of action at a range of temporal and spatial scales. At larger scales, it is imperative to incorporate within these tools how people may react to a changing resource base and the operation of policy levers. Understanding the interaction of people and natural resources is a particularly challenging aspect of developing sustainable resource management strategies.

It is also clear, however, that the degree of participation achieved in developing models and then using them to explore alternative options, is more important than the technical sophistication of the resulting models. In fact, for some applications a continuous and iterative process of model development and use, involving a range of stakeholders, rather than discrete model development and utility stages, is being adopted. In such cases simulation models and their outputs become integrative tools that are repositories of people's understanding about how things might work. There may be families of different models, and associated model output based on different assumptions, representing diversity in this understanding as well as attempts to achieve consensus. A critical feature of the Simile modelling environment is that it can be used to facilitate participation. There are two key elements to this:

- the ease with which people's ideas can be translated into a working model, facilitated by an intuitive model building environment, and
- the speed with which dynamic output can be obtained and viewed from plausibly complex models, facilitated by a suite of customisable user interfaces and the provision of skeleton models with a library of working submodels.

It is imperative to be able to combine the incorporation of stakeholders ideas with being able to rapidly view progress, in pragmatically relevant ways, in order to engage and maintain interest of participants.

The present FLAC users in Zimbabwe have achieved participation of stakeholders both at a professional level in organisations working on resource management issues where interdisciplinary teams have collaborated in model development, and of local communities, where model diagrams encapsulating understanding of causal relationships in natural resource management, developed through dialogue with local people, have been used as the basis for model development. This builds upon a tradition of using diagrams to arrive at consensual understanding about land use problems with farmers (Lightfoot et al., 1990; Galpin et al., 2000) and in acquisition of local knowledge (Walker et al., 1995) but delivers a more powerful tool for exploring their consequences.

While it is clear that the Simile modelling environment can be effectively used to facilitate a participatory modelling process, there is scope for adding a section to the FLAC manual to cover how users might go about engendering an effective participatory process. This could be distilled from the experience detailed in this FLAC process documentation.

Scale

At the outset of this FLAC project, FLORES models were defined in structural terms that situated them at a particular landscape scale with both weekly (operational decisions) and yearly (strategic decisions) time steps. This implied representation of socially disaggregated household units (that could be nested within larger social structures such as villages) interacting with a mosaic of individually represented patches of land. It is clear from discussing requirements with users and consideration of the actual models that have been developed during the FLAC process, that to address key issues in the management of miombo resources, models at various different spatial and temporal scales will need to be developed.

This suggests that a major re-orientation of the FLORES concept is required, in order to stress participatory development of suites of tools to support decisions at different scales, interacting with different policy contexts, rather than a generic forest simulator. In a miombo context; regional transnational, national, landscape and local community scales need to be engaged in order to handle trade-offs between rural livelihoods and conservation of resources.

The current focus on the landscape scale in the FLAC materials remains appropriate for training purposes, since it embraces what people need to learn about to implement models at a range of scales but it would be useful to consider in future:

- development of a suite of skeleton models suitable for application at different scales
- explicit consideration of scaling issues in FLAC documentation, and
- possibly, building in assistance in traversing scales within the modelling environment.

Capacity building and access to skills

It is clear from evaluation of individual workshops and the process as a whole, that people with little or no previous experience of modelling can pick up basic model development skills quickly using the FLAC materials, but that they need assistance from experienced people to gain confidence in choosing and implementing appropriate types of relationships to represent the behaviour that they wish to capture, particularly with respect to modelling human decision making processes.

At this stage it is unlikely that the FLAC materials alone could be used by novice modellers to develop plausible tools to assist decision taking about natural resource management in new forest margin contexts. New initiatives are likely to require some initial training input and support from experienced modellers and careful consideration, at the outset, of the institutional investment that is required to develop a critical mass of users at particular locations who are able to support eachother in acquisition of skills and implementation of locally relevant relationships. The experience in Zimbabwe suggests that critical mass and institutional investment in the modelling process both within organisations and amongst them in national consortia are important.

Feedback from participants in this project (see individual reports of training workshops) has been iteratively incorporated in the development of the FLAC materials and the Simile modelling environment so that the current versions are considerably more useful and user-friendly than the initial versions. Project participants were clearly appreciative of this because they saw issues that they had raised being implemented as the project unfolded. This has clearly enhanced the uptake and utility of the project outputs but makes evaluation more difficult since the final outputs are different from those that were actually used during the project. Users have a critical requirement for software that functions reliably with intuitive functionality backed up by comprehensive on line help. The fact that a range of organisations have remained engaged in the FLAC process, have incorporated a modelling approach within their work and have plans to continue using modelling as a central plank of their development activity in relation to miombo resources, are an effective endorsement of the utility of the project outputs.

Influencing a policy development process

During the present project, there has been a considerable shift in emphasis on how FLORES models can be most effectively used to influence policy. This begins with casting policy development as a process with several steps and multiple actors, operating at different scales, rather than to focus only on the final implementation of government policy by senior decision makers (Jager, 1998). Tools for exploring resource management options are required at a range of scales (household, community, landscape, nation and region) to be used by various actors in the policy development process (community based organisations, local government and non-governmental organisations, national and international government and non-governmental organisations). At smaller scales and earlier in the policy development process, the emphasis in the use of tools may focus on understanding resource management problems and opportunities, whereas at larger scales and later in the process the emphasis shifts to exploring the possible consequences of alternative options (Hazell and Wood, 2000). Participation of stakeholders, provides an essential link between these scales, since if there is local input and ownership of the basis for understanding and predicting possible outcomes, then they provide a more effective basis for negotiating alternative options amongst stakeholders. Critical development and use of simulation models in the policy development process is likely to center on local, national and international organisations who interact on the one hand with local communities and on the other with policy makers in government bodies.

There has not been sufficient time to chart changes in the implementation of new policy influenced by the development and application of FLORES modelling (FLAC training and model development only began in September 2000, so there has been a period of only six months so far in which to monitor its uptake and effectiveness). Even in this short time period, however, it is possible to see impact in the early stages of policy formulation and on the behaviour of some of the actors in this process – principally in the present miombo context, non-governmental organisations, initially working at community level (e.g. WWF, SAFIRE and the CIFOR ACM team). Key impacts have been to:

- foster interdisciplinary collaboration (ACM team),
- develop more explicit consideration of the social dimensions of natural resource management decisions (all groups),
- clarify definition of key policy issues and the cause and effect relationships contributing to them (all groups), leading to
- changes in how organisations interact with local communities, specifically in terms of the information collected as a basis for evaluating resource management issues (e.g. WWF changed the information they required to evaluate household fuel use decisions and TREP used local perceptions of cause and effect relationships as a basis for model development).

The next stages, that all groups have plans to enact, are to test and then run models together with stakeholders (e.g. SAFIRE with village resource committees in order to explore quotas for NTFP collection). The effectiveness of this stage will depend heavily upon the range and quality of input / output tools available within the Simile modelling environment and the ease with which they can be customized. This merits further participatory development of user interfacing, driven by the requirements that emerge from using the models in real world contexts.

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