Implementation Of A Water Quality Model By The Community – Some Lessons

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EXTENDED ABSTRACT

We live in an age where public policy is directed at empowering ‘people on the ground’, which increasingly places responsibility for natural resource management in the hands of the ‘community’. It is therefore essential that the community is able to fully understand and trust the outputs of biophysical models if they are to be effective tools in contemporary natural resource management.

Most commonly in the past, biophysical models have been commissioned by natural resource planners and implemented by technical experts to assist in determining optimal natural resource management outcomes. While we believe this approach has been somewhat effective, we would also suggest it has limited the realisation of the full potential of biophysical models, by often excluding the people with the most capacity to effect the desired changes determined from the modelling.

An Environmental Management Support System (EMSS) Model was implemented in the Maroochy catchment over an 18 month period in 2003–2004 by the Maroochy Catchment Community Modelling Team – an action research group composed of people from community, local government and natural resource management (NRM) agency backgrounds.

The EMSS is a catchment water quality model produced by the Cooperative Research Centre for Catchment Hydrology (CRCCH). EMSS predicts daily flow and pollutant loads for a catchment.

The work was undertaken due to the convergence of a range of circumstances including:

- the Maroochy catchment is currently experiencing a range of land use pressures
- since the inception of the Environmental Health Monitoring Program (EHMP) “Report Card”, the Maroochy catchment “health” has declined
- the release of the broad scale South East Queensland EMSS model commissioned by the Moreton Bay Partnership generated a high level of community interest and some scepticism, and
- there was a desire within the community to develop an understanding of catchment models and how they can and should be applied.

A series of workshops were conducted to look at all aspects of the model implementation and to train group members in the use of the model. Workshops covered a broad range of topics from learning how to use the EMSS model through to the collection and assessment of new data.

The result of this process is a water quality model for the Maroochy catchment that is widely trusted and understood.

There is a range of important outcomes from the process apart from building the model itself. These, include a broad acceptance and understanding of the model, access to high quality input data assessed through a framework of local knowledge, consensus and transparency in decision making, knowledge exchange and possibly most importantly, the building of relationships and trust between the stakeholders.

The outcomes of this process are the result of an unusual set of circumstances. Thus, some of the benefits and limitations of the modelling process will apply to modelling in general, while some will be specific to this particular situation.

The project highlights a range of benefits and limitations to community based implementation of natural resource models. While the process worked well in this particular instance, future implementations need to be considered in relation to the required modelling outcomes and the socio-political and economic context in which the model may be used. Future use of the Maroochy EMSS will increase understanding of the benefits and limitations of this modelling approach, as may its use in other similar settings.

1. INTRODUCTION

The Maroochy catchment in South East Queensland (SEQ), Australia, (Figure 1) is currently experiencing a range of land use pressures. Along with other areas in SEQ, there is significant urban and rural residential development pressure. In 2003, the Moreton Sugar Mill ceased production; with the result that sugar production is no longer a viable industry for Maroochy cane farmers. Hence, there is potentially about 10 000 ha of land that will change use in the short term. At the same time there are a range of governmental land use planning schemes and policies being implemented. These planning instruments will have significant impacts on potential future land use within the Maroochy catchment.

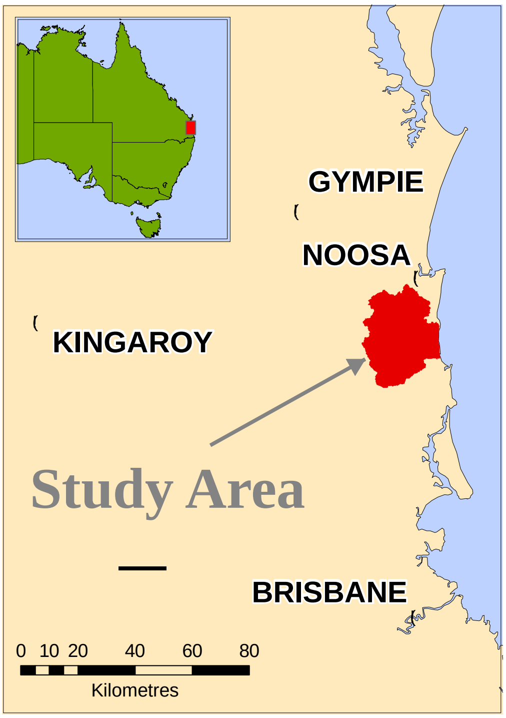

Figure 1. Location of the Maroochy catchment

The Moreton Bay Waterways and Catchments Partnership (MBWCP) has established an Ecosystem Health Monitoring Program (EHMP) in SEQ (EHMP, 2004). Every year this program produces a "Report Card" which describes and rates the "health" of catchments within SEQ. Since the inception of the EHMP the reported health of the Maroochy catchment has declined.

In 2001 the National Land and Water Resources Audit (NLWRA) produced a national scale SedNet model (Prosser *et al.*, 2001). This model covered the majority of Australian coastal regions. The SedNet model predicts long term annual sediment and nutrient loads exported from catchments. While this model was useful at the national scale there was a need for finer scale models to assist in understanding regional water quality issues.

In 2002, the Cooperative Research Centre for Catchment Hydrology (CRCCH) was commissioned by the MBWCP to develop an Environmental Management Support System (EMSS) to simulate runoff, sediment and nutrient loads within the entire SEQ region, including the Maroochy catchment (Chiew *et al.*, 2002). Since the model produced was based on broad scale data sets, its use was appropriate only for regional planning purposes.

After the public release of the SEQ EMSS, there was increased interest amongst sectors of the Maroochy catchment community pertaining to the EMSS model. Members of the Maroochy catchment community felt the EMSS might be a useful tool, if the model could be implemented with finer scale data that was more appropriate for the analysis of local issues.

At the same time, the Cooperative Research Centre for Catchment Hydrology (CRCCH) was aiming to increase the use and understanding of its modelling tools within the wider community. To facilitate this process the CRC and its partners including the Department of Natural Resources and Mines (NR&M) embarked on a training and support programme for EMSS.

With the convergence of these circumstances an opportunity arose at the end of 2003 to implement an EMSS model for the Maroochy catchment, using the best available natural resource data. The aim from the outset was to produce a model that would be widely used and accepted by natural resource managers within the catchment. Inspired by Maroochy Landcare, a community based group called the "Maroochy Catchment Community Modelling Team" was formed to undertake the EMSS modelling for the Maroochy catchment.

2. THE MAROOCHY EMSS MODEL

EMSS is a catchment water quality model produced by the Cooperative Research Centre for Catchment Hydrology. EMSS predicts daily flow and pollutant loads for a catchment. EMSS estimates loads for:

- Total suspended sediment (TSS)

- Total nitrogen (TN) and
- Total phosphorous (TP).

The Maroochy Catchment Community Modelling Team implemented a version of the EMSS using the best currently available data (Searle, 2005).The model was run for an arbitrary 21 year period, from 1980–2000. EMSS predicts that the Maroochy catchment generates on average:

- 22350 tonnes sediment / year
- 420 tonnes nitrogen / year
- 11 tonnes phosphorus / year.

Figures 2 through 4 show the total annual loads predicted by the model for TSS, TN and TP.

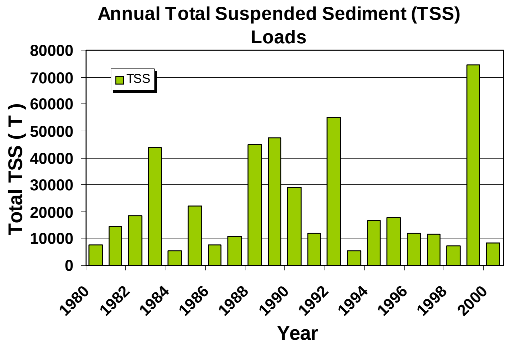

Figure 2. Annual predicted total suspended sediment loads at the Maroochy River mouth.

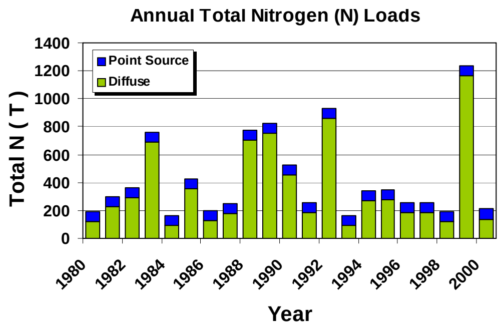

Figure 3. Annual predicted total nitrogen loads at the Maroochy River mouth.

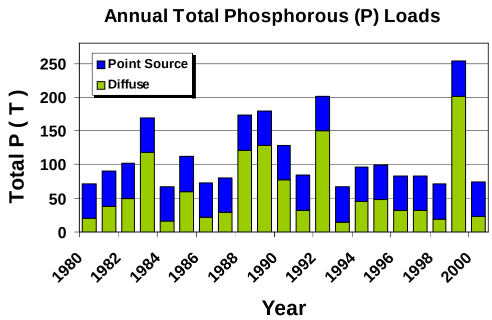

Figure 4. Annual predicted total phosphorous loads at the Maroochy River mouth.

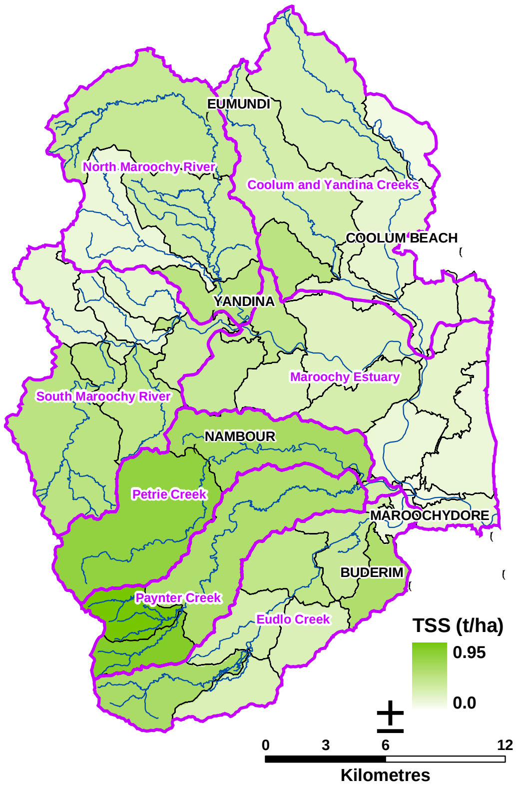

Figure 5. Annual average sediment generation per model sub-catchment.

Figure 5 shows the predicted spatial distribution of annual average sediment generation within the catchment.

3. HOW DID THE COMMUNITY MODELLING PROCESS WORK?

The Maroochy EMSS Model was implemented during an 18 month period in 2003 – 2004 by the Maroochy Catchment Community Modelling Team – an action research group.

The Maroochy Catchment Community Modelling Team was made up of two distinct groups, called the ‘Active Modellers’ and the ‘General Interest Group’. The Active Modellers were directly involved in most aspects of the model implementation and attended most of the sessions. In contrast, the General Interest Group consisted of people who kept a watching brief and only attended sessions they considered of direct interest.

The Active Modelling Team consisted of thirteen members from Maroochy Landcare, Maroochy Water Watch, Maroochy Shire Council, the QLD Environmental Protection Agency (EPA), the QLD Department of Primary Industries (DPI), Moreton Bay Waterways and Catchments Partnership and the QLD Department of Natural Resources &

Mines (NR&M). The General Interest Group also included other members from these bodies as well as members from the Sunshine Coast University, Maroochy Water Services and SEQ Natural Resource Management Body. All members of the team were involved in the project due to a genuine interest in learning about the EMSS model and how its results could be applied to catchment management in they were stakeholders. The fact that all participants were willingly involved is an important consideration when looking at the outcomes of this project.

How well the Maroochy Catchment Community Modelling Team represented the 'community' of the Maroochy catchment is also a point of interest. There was no formal process to invite participants to be involved in the modelling team. It was not an objective of the team to represent a complete cross-section of the people who live in the catchment. Rather the group was formed through existing professional and social networks. Throughout the project new members to the team were welcomed if people expressed a desire to be involved. Membership was informal and flexible. There were no prerequisites or formal time commitments imposed on any team members.

In order to learn about and implement the EMSS for the Maroochy catchment, the team held a series of workshops addressing relevant topics. Workshops were held approximately every 4-6 weeks and generally went for about half a day. Venues for the workshops included community halls, team member's residences and organisation's offices. The topics for each of the workshops were planned by the group every 6 months and a work program established to facilitate these.

Workshop topics included but were not limited to:

- learning how to use the EMSS model interface
- analysing the biophysical concepts of the model and how well these were implemented e.g. model sensitivity
- comparing the pros and cons of EMSS to other, similar models
- learning about other modelling work being undertaken in the catchment
- sourcing and critically assessing the best data for input into the model
- reviewing model outputs
- development of model scenarios relevant and applicable to catchment issues, and
- investigation, assessment and collation of new data to supplement the available model inputs.

We suggest four key ingredients that were essential to the successful completion of the project:

- the existence of an issue (in this instance 10000 ha of cane land that was about to change use) that was sufficient to motivate community, industry and local and state government decision-makers to be included in the process
- a dedicated modeller to run the model and provide a base level of training to team members
- a dedicated workshop facilitator to run the workshops (as well as conduct research into how the process was working), and
- a core group of individuals to organise and administer the process to keep things running.

4. WHY DID WE USE THIS APPROACH TO CATCHMENT MODELLING?

Since the advent of computers, simulation models have been used to assist in a broad range of decision making processes. Most commonly in the past, biophysical models have been commissioned by natural resource planners and implemented by technical experts to assist in determining optimal natural resource management outcomes. In many circumstances this traditional approach to implementing a model is often the most efficient and appropriate e.g. when an agency has an issue for which it is solely responsible and accountable, it is appropriate to confine the modelling process to the technical experts.

While we believe this approach has been somewhat effective in the past we would suggest it has also limited the realisation of the full potential of biophysical models, often excluding the people with the most capacity to effect desired changes determined from the modelling.

We live in an age where public policy is directed at empowering 'people on the ground' and often placing responsibility for natural resource management in the hands of the 'community'. It is therefore essential that the community is able to fully understand and trust the outputs of biophysical models if they are to be effective tools in contemporary natural resource management.

5. LESSONS FROM THE COMMUNITY MODELLING PROCESS

The outcomes of this modelling process are the result of an unusual set of circumstances. Thus, some of the benefits and limitations of the modelling process will apply to modelling in general, while some will be specific to this particular situation.

Given the recent completion of the modelling work, the Maroochy EMSS has only been applied in one 'real life' situation. The Maroochy Shire Council has used the EMSS to assist in deciding where to locate revegetation works. There are a number of other uses for the model planned for the future. As these occur our understanding of the benefits and limitations of this modelling approach will be enriched.

5.1. The benefits

There is a broad range of accompanying and equally important outcomes from the process, aside from the model itself.

The Maroochy community now has a water quality model that is accepted by a diverse range of stakeholders from rural landholders through to agency policy and planning staff. While this group of people is only a small sample of the entire Maroochy community, these people do have considerable spheres of influence. It would be our hope that as the model is used more widely this group is able to guide other users of the model and provide critical comment.

The Maroochy community now has a group of people who have a robust understanding of the positive and negative aspects of using models to assist in natural resource management. Often in the past, models have been promoted in the community as providing 'the answer'. Having been through a rigorous analysis of the EMSS, the Maroochy Catchment Community Modelling Team now understands when and how it is appropriate to apply biophysical models to assist in natural resource management decision making. This understanding will hopefully assist the broader community in the appropriate application of model results.

We believe that by having a broad spectrum of the catchment community involved in the model development, we have been able to source all of the best input data for the model. As an example there were a number of versions of the digital elevation model (DEM) available. After careful analysis by the team it was determined that one DEM in particular was superior for this specific purpose and as such was used. Typically the modeller may just tend to use whatever version of a dataset was available without the benefits of the local understanding. All members of the team brought data that was useful and sometimes difficult to source.

Additionally, the combined knowledge of the team improved the interpretation of data used to generate model inputs. The group process allowed for the incorporation of local knowledge into the model. Typically in a modelling process the 'modeller' may be called on to make various judgment calls in relation to input data or the most appropriate modelling algorithms to use. Having a broad range of local knowledge available in these situations enhanced the decision making significantly.

The accompanying benefit to this is that if a controversial judgment call has to be made there is an agreed position and an understanding why the decision was made. This particular issue is often the cause for models to be rejected. Due to limitations of data or the ability of algorithms to adequately describe complex processes, the modeller may make well reasoned, correct judgment calls. However the reasoning often is not communicated when model results are presented. Hence these decisions may often appear as outlandish or lacking local knowledge, resulting in mistrust of the model. Having the ability to use consensus decisions in a transparent manner greatly improves the faith that people are willing to put into the model results.

As well as leading to consensus decisions, this approach also provides a forum for the exchange of knowledge. Biophysical models, by nature, break down complex landscape processes into more readily understandable components. This provides a useful framework for discussions and shared learning about how catchments function. It is all too easy for us to focus on our specific area of expertise. The rigorous implementation of a model forces us to broaden our perspective and affords us the opportunity to learn from others.

Possibly the most important outcome from this approach to modelling, for us was the building of professional and personal relationships and the development of trust amongst the team. Often the way community and agencies interact does not always engender feelings of trust. We all came to this process with our own inherent agendas, but the transparent process forced us to acknowledge the skills and abilities of other team members. As individuals working towards a common goal it was easier to build understanding and trust of each other, even when we did not always agree. This new level of trust and respect will hopefully auger well for future collaborative work.

5.2. The limitations

While this process has benefits, there are limitations that must also be considered.

This type of approach is only appropriate in certain circumstances dependant on the required outcomes of the modelling process. It would be inefficient and irrelevant to embark on this approach where community members were not part of the solution in effecting change resulting from modelling outcomes, and where the issue was not sufficiently important to motivate the participation of prospective participants.

This process takes a long time. By its very nature of being inclusive, it generates problems regarding the scheduling of workshops. Long term forward planning and commitment from team members are critical in overcoming this problem.

The process can also only move as fast as people within the team are comfortable with. Biophysical models such as EMSS can be very complex, and significant portions of time are required to begin understanding them even at the broadest level. Moving too quickly and not allowing team members to gain a level of understanding they are comfortable with would defeat the key purpose of this process.

This process is also yet another impost on people's time. Community members are constantly being called on to donate their time and knowledge to a broad range of agency sponsored activities. There are obviously limits to how involved individuals can be in all of these activities; hence it is important that there are benefits to be had by all involved in the process. High levels of participant motivation are key to a successful outcome.

From the community group perspective it is disappointing that they have not so far been able to use the completed model themselves to any great extent. This is because, to date, their volunteers have not had the time available to do the work.

This process has been honest and transparent, and as such, it has exposed weaknesses in the model, the available data, and the skills and knowledge of the people involved. Hidden agendas or defensive attitudes could easily have derailed this type of process. It is important that people are willing to accept weaknesses at all levels, and work on improving these where appropriate.

6. CONCLUSIONS

The result of this process is a water quality model for the Maroochy catchment that is widely trusted and understood by a range of key stakeholders within the community. There are a broad range of important outcomes from the process, apart from building the model itself. These include a broad acceptance and understanding of the model, access to high quality input data and local knowledge, consensus and transparency in decision making, knowledge exchange and possibly most importantly, the building of relationships and trust between the stakeholders.

The project highlights a range of benefits and limitations to community-based implementation of natural resource models. While the process worked well in this particular instance, future implementations need to be considered in relation to the required modelling outcomes, and the nature of the context in which the implementation process may occur. Future use of the Maroochy EMSS will increase our understanding of the benefits and limitations of this modelling approach, as may implementation of this process in other context-appropriate situations.

7. ACKNOWLEDGMENTS

The development of the Maroochy catchment EMSS model has been a collaborative effort involving a great many individuals. Those in the Maroochy Catchment Community Modelling Team who have directly contributed to the development of the model include: Jon Burgess (QLD Department of Natural Resources & Mines), Steve Dudgeon (Maroochy Shire Council), Cerran Fawns (Maroochy Water Watch), Gwyn Griffith (Maroochy Landcare), Bill McFarlane (Queensland Environmental Protection Agency), John Muir (QLD Department of Primary Industries), Peter Oliver (QLD Department of Natural Resources & Mines), Mark Sallaway (QLD Department of Natural Resources & Mines), Andrew Todd (Maroochy Water Watch), Tony Weber (WBM Oceanics), Belinda Wedlock (Maroochy Shire Council) and Jacky Williams (Maroochy Landcare).

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