ENVIRONMENT & SOCIAL TECHNICAL NOTE

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A Structured Approach for Visualisations of Indicators of Sustainable Forest Frameworks

Summary

Demonstrating the sustainability of forestry in New Zealand to international and national community standards needs to address stakeholder values on forest sustainability. This is important for the industry's 'license to operate'.

As part of the research on utilising visualisations for communicating sustainable forestry, a structured approach was developed for mapping stakeholder values to data and visualisations, via indicators from international frameworks of sustainability. This structure then forms the basis for the development of automated visualisations and can be used for the development of software for such visualisations. The visualisations can be used for international reporting on forest management, and for communications with stakeholders.

This note illustrates the design issues for the visualisations structure through an example based on the values stakeholders have for water from planted forests, and shows the schema for the structure.

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Background

International social trends show increasing requirements for evidence that forestry practices are sustainable. Visualisations are effective for communicating complex messages, hence provide new opportunities for demonstrating sustainable forest management in an easy to understand and accessible way.
A number of New Zealand datasets are relevant for demonstrating sustainable forest management, and can be shown as maps and graphs. However, shown as individual datasets they may only be of limited use for depicting sustainability to stakeholders in New Zealand's planted forests. A structured approach for developing visualisations is described. This approach will help to facilitate the development automated visualisations from forestry and related data. These visualisations can be used for national and international reporting, and wherever communications on the sustainability of New Zealand forest management is required.

Mapping Visualisations to Values

Stakeholders are more likely to accept that forest management is being practiced sustainably if they are shown information relevant to issues they consider important. Hence it is useful to understand stakeholders' values. Previous research investigated the values of five stakeholder groups: forest users, forest managers, territorial local authorities, central government and international views. These values were mapped to a framework of indicators for sustainability [1]. The mapping approach is demonstrated for a subset from the values research; the subset covers some of the values that relate to water from planted forests, for four of the stakeholder groups. Figure 1 shows this subset example in the form of a concept map, a graphical way of representing concepts (in this case the values of the forest and water example) and the links between them. Table 1 lists how the values in Figure 1 were mapped against the indicators of the Montréal Process Criteria and Indicators, the FSC Principles and Criteria, and the draft FSC Indicators [2].

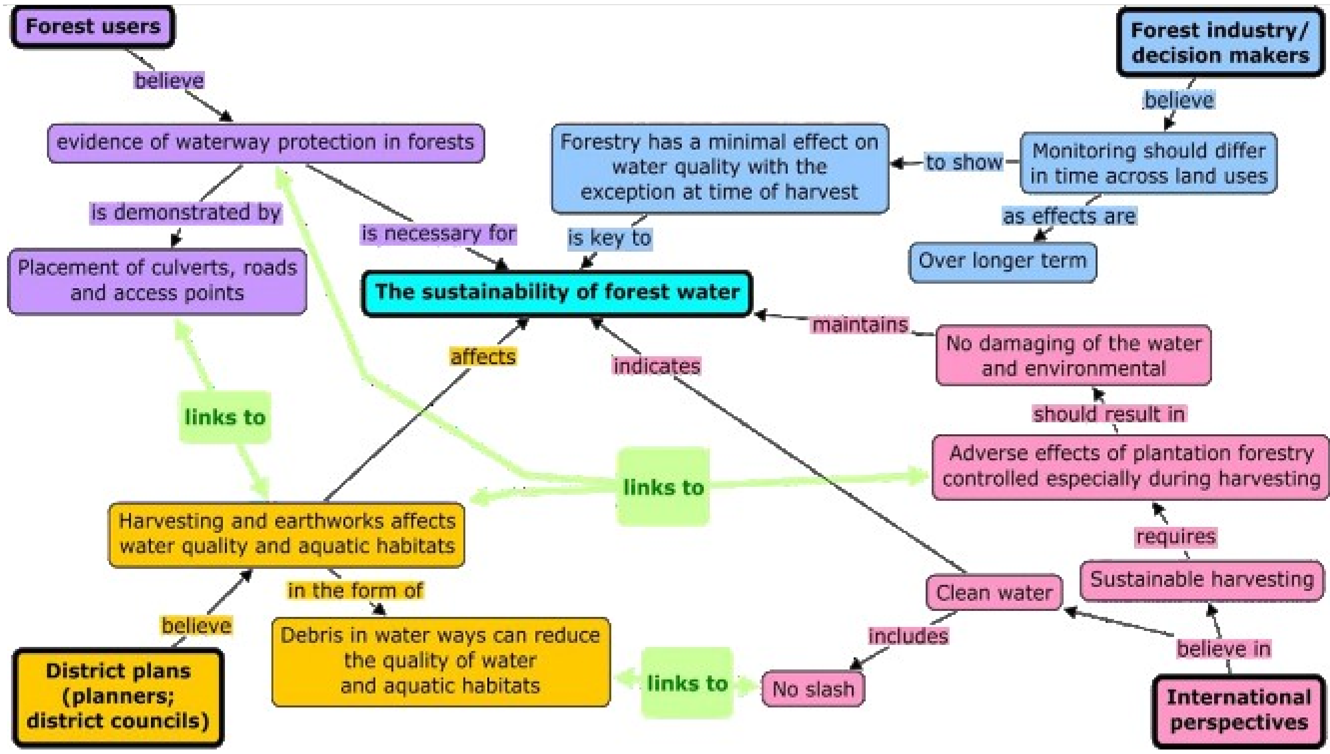

Figure 1. A concept map of a subset of stakeholders' values regarding the sustainability of forest water. The stakeholder groups included in the subset are shown in the corners of the figure. The stakeholders' values are shown in the rectangular boxes (the concepts). Each stakeholder group's concepts are drawn in matching colours, with connections that can be 'read' in the direction of the arrows. The graphical representation of concepts facilitates the exploration of common or similar concepts, here depicted by green links.

Table 1. Stakeholder values mapped to the Montréal Process Indicators, the FSC Criteria, and the draft FSC Indicators. The values shown are a subset from the theme 'water from planted forests'

Stake-holders	Value	Montréal Process Indicator	FSC Criteria	FSC Indicators
Forest user	Evidence of waterway protection in forests	4.3.a	6.5, 10.6	6.5.1.3
	Placements of culverts, roads and access points	4.3.a	6.5, 10.6	6.5.7
District councils	Harvesting and earthworks affects water quality and aquatic habitats	4.3.a	6.5, 10.6	6.5.7
	Debris in waterways can reduce the quality of water and aquatic habitats	4.3.b	6.5, 8,2, 10.6	6.5.1.3, 8.2.11L
Forest managers	Forestry has minimal effect on water quality with the exception at time of harvest	4.3.b	10.8	10.6.1
	Monitoring should differ in time across land uses	4.3.b	8.2, 10.8	8.2.11L
	Longer term effects	4.3.b	8.2, 10.8	8.2.11L
International	No damaging of the water and environment	4.3.b	6.5, 10.6	6.5.1.3, 10.6.3
	Adverse effects of plantation forestry controlled especially during harvesting	4.3.a	6.5, 10.6	10.6.3
	Sustainable harvesting	2.d	8.2	8.2.1L, 8.2.5L, 8.2.1S
	Clean water	4.3.b	5.5	5.5.1L, 5.5.1S
	No slash	4.3.b	6.5, 8.2, 10.6	8.2.11L, 10.6.1

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Indicators are still at a relatively high level. For example, the Montréal Process indicator 4.3.a “Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources.” They typically do not specify what measurements or verifications need to be made. Hence an intermediate step was needed to define the topic(s) to be visualised for an indicator, where those issues are sufficiently detailed to provide a link between the indicator and relevant data and hence also visualisations of this data. While the intermediate step was developed to be sufficient for linking indicators with visualisations, the list of links developed is not exhaustive and the design allows for additional topics to be added. The structured approach linking values to visualisations is given in the Appendix, while Table 2 lists the links for some of the values of the forest-water example and Figure 2 shows an example approach for showing the links to a user.

Table 2. Example visualisation topics developed to link values (via indicators/criteria) to data freely available in New Zealand, forming the basis for the development of visualisation options

Stakeholder value	Indicator / criterion	Visualisation topics	New Zealand data
Debris in waterways can reduce the quality of water and aquatic habitats Forestry has minimal effect on water quality with the exception at time of harvest Longer term effects Monitoring should differ in time across land uses No damaging of the water and environment Clean water No slash	MP 4.3.b Streams in forest with significant change from reference conditions	Woody debris in waterways Sediment in waterways Aquatic biodiversity	Soil water balance [3] Rainfall data - Daily at 5km resolution Predicted current rainfall - NIWA 40-year normals Predicted high intensity rainfall risk under climate change - NIWA HIRDS Erosion risk: NZEEM; susceptibility; LRI; Sinmap Historical slips - study sites only Mapped slips (LCDB1&2, LUM) - Summer 1996/7 and 2001/2002, 2011 Freshwater Environments NZ (FENZ) - Ecological priorities for freshwater Landcover (vegetation types) - veg. types mitigate risk; vegetation shading as proxy for water temperature Harvest operations - user specified New harvest roading - approximations using FIF Land use (or landcover as proxy) – nutrient leaching
(Similar to above) ***This entry is a placeholder to show values can be mapped to topics and data via different sustainability systems***	FSC 10.6 Harvesting, roading… shall not result in… adverse impacts on water	As for woody debris and sediment above	(Similar to above)

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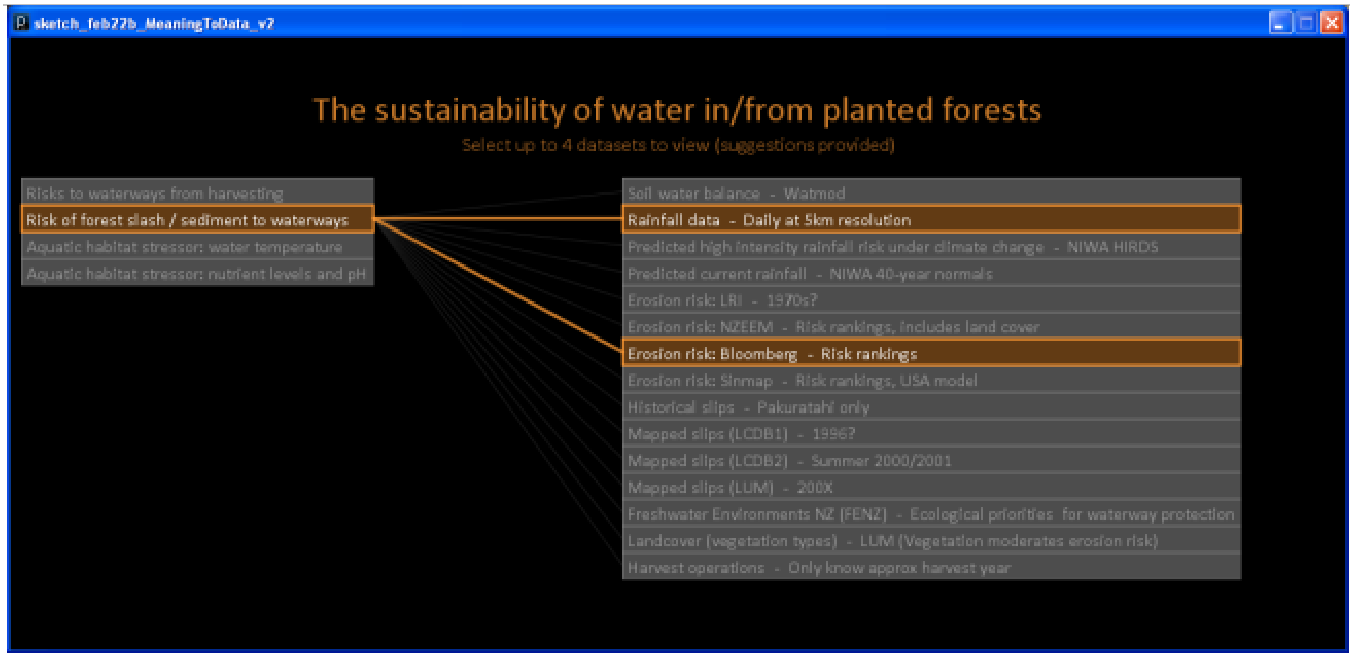


Figure 2. Linking options are being explored; this text-based approach offers default datasets and allowing the user to select other to explore

Data relevant to an indicator can be viewed individually, e.g. a map or graph showing shaded stream lengths over time to indicate preferred water temperatures for aquatic biodiversity habitat conditions. Understanding sustainability, however, requires these individual factors and their interrelationships be considered. Figure 3 includes a component to allow for visualisations of these interrelationships, where they exist, to more fully explain sustainable forestry. The relationships can be through existing models or expert knowledge.

Best practice is to ensure a viewer is informed about the accuracy of the data and relationships displayed.

Conclusion

This framework can be used to show different levels of detail to the viewer. If the data available is sufficient for the current state of a sustainability issue to be known and the trend can be determined, then the visual can be summarised to a high level e.g. a green tick, or details can be shown.

High level summaries are frequently represented as an improvement or decline (or no change) for the country. For example, showing them in red/yellow/green or sad/happy faces. National monitoring, however, targets only certain variables and the state of an indicator or topic within it may need to be inferred from surrogate information. While the 2008 Montréal Process report for New Zealand[4] reflected on the then current New Zealand state of an indicator, only the trend and the quality of information were presented.

The ability to visualise the interrelationships between datasets allows viewers to explore changes that would occur in response to social, environmental or economic pressures. This allows the effects of certain forestry operations or weather events to be visualised, providing the user with a clearer picture of risk.

References

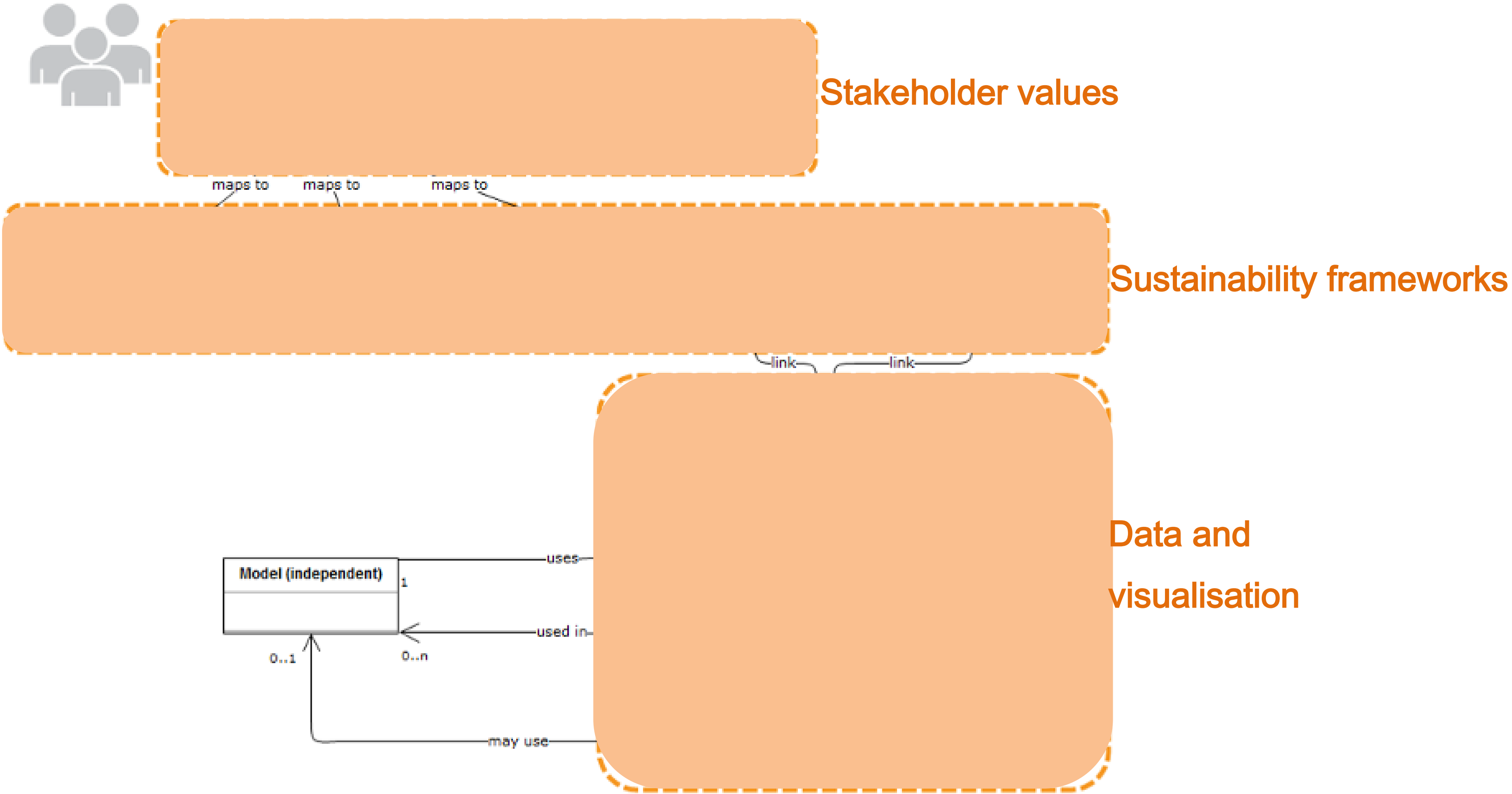
1. Hock, B. and Clinton, P. Determining Priorities for Sustainability Research on New Zealand Forestry. FFR Environment and

Social Technical Report No. FFR- ES012. (2010).

2. FSC Guideline. FSC Forest Stewardship Standards: structure, content and suggested indicators. FSC-GUI-60-004 (V1-0) EN. www.fsc.org (2010).
3. Watt, M.S., Kiyvyra, A.L., Clinton, P.W., Coker, G., Parfitt, R.L., Simcock, R., Dandoc, J., Davis, M.R. and Schoenholtz, S.H. Modelling water balance in fertilised and unfertilised *Cupressus lusitanica* and *Pinus radiata* grown across an environmental gradient. Forest Ecology and Management, 255(3–4):1104–1112 (2008).
4. Sustainable management of New Zealand's forests: The 2008 New Zealand country report on the Montréal Process criteria and indicators. www.mpi.govt.nz (2008).

Appendix

Schematic of visualisation system
(Depiction is on the following page)



Design of the visualisation system showing links between components. This schema can be used for designing software

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