



Research article

Mapping discourses using Q methodology in Matang Mangrove Forest, Malaysia



Jean Hugé^{a, *}, Katherine Vande Velde^a, Francisco Benitez-Capistros^{a, b}, Jan Harold Japay^a, Behara Satyanarayana^c, Mohammad Nazrin Ishak^c, Melissa Quispe-Zuniga^{a, d}, Bin Husain Mohd Lokman^c, Ibrahim Sulong^c, Nico Koedam^b, Farid Dahdouh-Guebas^{a, b}

^a Systems Ecology & Resource Management Unit, Université Libre de Bruxelles (ULB), Brussels, Belgium

^b Laboratory of Plant Biology and Nature Management, Vrije Universiteit Brussel – VUB, Brussels, Belgium

^c Mangrove Research Unit (MARU), Institute of Oceanography and Environment (INOS), Universiti Malaysia Terengganu – UMT, Kuala Terengganu, Malaysia

^d Zentrum für Entwicklungsforschung (ZEF), University of Bonn, Germany

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ABSTRACT

The sustainable management of natural resources requires the consideration of multiple stakeholders' perspectives and knowledge claims, in order to inform complex and possibly contentious decision-making dilemmas. Hence, a better understanding of why people in particular contexts do manage natural resources in a particular way is needed. Focusing on mangroves, highly productive tropical intertidal forests, this study's first aim is to map the diversity of subjective viewpoints among a range of stakeholders on the management of Matang Mangrove Forest in peninsular Malaysia. Secondly, this study aims to feed the reflection on the possible consequences of the diversity of perspectives for the future management of mangroves in Malaysia and beyond. The use of the semi-quantitative Q methodology allowed us to identify three main discourses on mangrove management: i. the optimization discourse, stressing the need to improve the current overall satisfactory management regime; ii. the 'change for the better' discourse, which focuses on increasingly participatory management and on ecotourism; and iii. the conservative 'business as usual' discourse. The existence of common points of connection between the discourses and their respective supporters provides opportunities for modifications of mangrove management regimes. Acknowledging this diversity of viewpoints, reflecting how different stakeholders see and talk about mangrove management, highlights the need to develop pro-active and resilient natural resource management approaches.

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1. Introduction

Mangrove forests are highly productive (sub-)tropical ecosystems offering a variety of ecosystem services entailing provisioning (e.g. timber production), regulating (e.g. wave attenuation & storm protection; carbon storage) and spiritual (e.g. sacred forest) functions (Donatà et al., 2011; Duke et al., 2002; Mangora and Shalli, 2014; Mukherjee et al., 2014; Walters et al., 2008). This plurality of functions is scientifically validated, yet mangroves are increasingly threatened by conversion for aquaculture, agriculture and plantations, by infrastructure development, by pollution,

overharvesting and anthropogenic climate change (Alongi, 2002; Mukherjee et al., 2014; UNEP, 2014). If the current trend continues, South-east Asia in particular will experience a potential loss of mangrove cover of up to 35% (compared to 2000) in the near future according to UNEP (2014).

The ever-increasing body of scientific knowledge stressing the key functions of mangroves appears not to be sufficient as a strategy to curb mangrove loss and degradation, and tends to downplay other factors influencing decisions on natural resources management, such as interests, values and viewpoints (Rose, 2014). Given the importance of acknowledging value plurality in designing sustainable management strategies, a better understanding of the reasons why people in particular contexts do manage mangroves in a particular way is needed (Mace, 2014; Tallis and Lubchenco, 2014). Conservation and management of natural resources

* Corresponding author.

E-mail address: Jean.Huge@ulb.ac.be (J. Hugé).

requires the consideration of multiple stakeholders' perspectives and knowledge claims (Forrester et al., 2015) for informing complex and possibly contentious decision-making dilemmas (Rastogi et al., 2013).

Next to the diversity in current ecological thinking among professionals (Moore et al., 2009; Sandbrook et al., 2010), other stakeholders – whose expertise is often pertinent and complementary to scientific expertise *sensu stricto* (Burgman et al., 2011) – also exhibit a wide range of perspectives on both the objectives and the process of ecosystem management (Mace, 2014). Although individuals may express a wide range of divergent viewpoints, when compared among each other, the high number of viewpoints usually can be clustered into a limited number of shared 'group viewpoints'. When a structured way of interpreting, thinking and representing things is shared among a group of people, a 'discourse' emerges (Dryzek, 2005). Discourses are defined as structured and shared ways of representations that evoke particular understandings, and that may subsequently enable particular types of actions (Hugé et al., 2013). As Mace (2014) notes, shifts in discourses regarding conservation and environmental management are centered on the relationships between human and nature, which affects the integration of science into conservation. The diverse set of ethics, ranging from intrinsic to instrumental views on nature, does not need to lead to a stalemate – quite the contrary, the acceptance of diverse values is a condition for joint progress (Tallis and Lubchenco, 2014). Understanding various stakeholders' discourses is essential in order to inform future sustainable management regimes and to progress towards conflict resolution, and ultimately to halt the loss of mangrove forests (Mace, 2014; Magole and Magole, 2009; Redpath et al., 2015). Recognizing the reality of the plurality of perspectives, as well as the associated importance of inter-stakeholder relationships which are mediated by a variety of governance approaches, this study focuses on the identification of stakeholder discourses regarding the management of Matang Mangrove Forest Reserve in Malaysia.

2. Current status & management regime of Matang Mangrove Forest Reserve

Matang Mangrove Forest Reserve (hereafter MMFR) covers an area of approximately 40,000 hectares (ha) along a 52 km long coastal stretch located in the State of Perak on the west coast of peninsular Malaysia (4°15'–5°1' N; 100°2'–100°45' E) (Ibharim et al., 2015). MMFR has been managed for silvicultural purposes for more than a century (Chong, 2006; Jusoff and Taha, 2008). Nearly 30,120 ha is treated as productive forest for pole and charcoal production while the remainder is categorized respectively as 'protective', 'restrictive', 'productive' and 'unproductive' areas (Ariffin and Mustafa, 2013; Goessens et al., 2014). The management regime in the productive forest is based on a 30-year rotation with first and second thinning for pole production (when the trees reach 15 and 20 years respectively), and clear-felling (when the trees reach 30 years), for charcoal production. Part of the clear-felled areas are replanted with *Rhizophora* spp. after two years.

The management of MMFR is designed, carried out and supervised by the Forestry Department of the State of Perak, which releases a comprehensive 'Working Plan' once every ten years (Ariffin and Mustafa, 2013) and allocates permissible (productive) forest land areas to pole and charcoal contactors. The most recent plan was released in 2013 (Ariffin and Mustafa, 2013). However, the mapping of MMFR using multi-temporal satellite images revealed both the loss of 8000 ha of mangrove cover due to erosion, encroachment by oil palm plantations, paddy fields and shrimp ponds and the gain of 3000 ha through replanting between 1993 and 2011 (Ibharim et al., 2015). Goessens et al. (2014) concluded

that the mangroves at MMFR are sustainably rejuvenating from a silvicultural point of view, however recent studies contributed to progressing insight in the understanding of the multidimensional social and ecological sustainability of the mangroves (Ammar et al., 2015a, 2015b).

3. A plurality of perspectives on mangrove management

The plurality of perspectives on the management of natural resources leads to a range of questions, especially in a quasi-single-use management regime as currently implemented in MMFR. While Section 2 gives a *descriptive* outline of the current management regime – a regime which is publicized in policy documents (Ariffin and Mustafa, 2013) and in some scientific works (Ahmad, 2009; Ammar et al., 2014) as resulting in '(one of) the world's best managed mangrove(s)' – this paper aims to map the diversity of subjective viewpoints on the management of MMFR, and will hence possibly result in a range of *prescriptive* modifications of the management regime. Inevitably plural subjective viewpoints may indicate desirable alternative states on how future management regimes could or should be like. Acknowledging this diversity of viewpoints, reflecting how different stakeholders see and talk about mangrove management, highlights the need to develop proactive and resilient natural resource management approaches (Moore et al., 2009).

Stakeholders may have divergent views on who should own and control the use of the mangroves, on what mangrove functions should be maximized, and on who should make the decisions on how the resources should be managed and used, on who should benefit *etc.* On a more general level views may diverge on the sustainability of the current management regime from a socio-economic and ecological perspective, reflecting both the constructive ambiguity of the multi-interpretable sustainability concept (Waas et al., 2011) and – the currently largely unstudied-functioning of the Matang mangrove socio-ecosystem.

Consequently, this paper aims to:

- Identify and characterize the diversity of stakeholder perspectives with regard to the management of Matang Mangrove Forest Reserve;
- Reflect on the possible consequences of the diversity of perspectives for the future management of Matang Mangrove Forest Reserve.

4. Methodology

4.1. Q methodology: an outline

Q methodology (henceforth Q) is used to study subjectivity and inter-subjectivity in a structured and statistically interpretable form. It combines the qualitative study of attitudes with the statistical rigor of quantitative research techniques (Barry and Proops, 1999; Rastogi et al., 2013; Watts and Stenner, 2012). Participants record the way they think about statements relative to other statements, which forces them to focus their attention on the issues they believe are most important (Sandbrook et al., 2010). The results of each participant's ranking is then compared with the other participants' rankings, resulting in a correlation matrix which allows us to statistically probe for patterns of association between participants. The pre- and post-sorting interviews provide essential input for the interpretation of the participants' viewpoints. Q methodology is widely used in social science research and is increasingly adopted in natural resource management and conservation research (Chapman et al., 2015; Davies and Hodge, 2007;

Forrester et al., 2015; Lansing, 2013; Milcu et al., 2014; Sandbrook et al., 2010; Visser et al., 2007; 2011; Zanoli et al., 2015).

We chose the Q methodology because of the heterogeneous nature of the subject matter (*i.e.* the plurality of viewpoints with regard to mangrove management in MMFR) and because of the relevance of the selected stakeholders' viewpoints with regard to mangrove management in MMFR (Watts and Stenner, 2012).

4.2. Data collection

Data in Q are collected through a series of steps. The first step in a Q is the development of the so-called *concourse*, which is the body of information about the research topic (in this case: the body of available information on the management of MMFR), from which a 'Q set' is taken. The Q set entails a list of statements ('a shortlist'), generated from the more elaborate *concourse*.

Secondly, Q participants are selected and asked to rank the statements of the Q set, which produces a series of Q sorts (one Q sort per participant). These Q sorts are subsequently analyzed through correlation and factor analysis to reveal patterns of association of viewpoints among the participants. Finally, each statistically extracted pattern (factor) is then interpreted, which yields a range of discourses with regard to the topic at hand (Watts and Stenner, 2012).

4.3. Q set design

The selection of statements to include in the Q set is based on the *concourse*, which ideally reflects the complexity and diversity of the discourses regarding the management of MMFR and its alleged sustainability. The development of the *concourse* was based on a review of the scientific literature (including a library search at the Forestry Research Institute of Malaysia (FRIM)), on a search for 'grey literature' and on exploratory interviews. Scientific literature was accessed through keyword-based searches in the title and topic (including: Matang AND management, Malaysia AND mangrove) on the Web of Science (www.webofknowledge.com), ScienceDirect (www.sciencedirect.com) and Scopus (www.scopus.com) platforms. Five preparatory interviews were conducted in Kuala Lumpur and Kuala Sepetang in April 2015 with key stakeholders having a general overview of the topic (so-called 'helicopter' persons (Hajer, 2006)). The initial *concourse* contained 159 statements, which were reduced into 48 statements by identifying key themes within which opinions on MMFR had been expressed within the *concourse* (functions, state of and threats to the mangrove, management, actors). To avoid potential biases brought about by the authors' subjectivity, we used a 'structured approach' (Watts and Stenner, 2012) to reduce the *concourse* into a final, manageable set of statements to be presented to the Q participants. A similar approach was used by Sandbrook et al. (2010), by Benitez-Capistros et al. (2016). This allowed us to condense the clustered statements of the *longlist* into a *shortlist* of statements. These 48 statements formed the Q set (Table 1) that was subsequently provided to the participants. The Q set was piloted and slightly modified after a pilot test with two local researchers (as suggested by Brown et al., 2015), in order to ensure that the questions were understandable in English and in Malay (Bahasa Malaysia). Every Q set statement presents a set of condensed information, the *-malleable-* meaning of which is to be attributed through the participants' interpretations during the Q sorting stage (Watts and Stenner, 2012).

4.4. Selection of participants

In the process of selecting participants for the Q (as in the

process of designing the Q set) we aimed to create the conditions for discursive representation (Dryzek and Niemeyer, 2008), *i.e.* ensuring the representation of a range of stakeholders who represent the diversity of perspectives and opinions regarding the management of MMFR. Based on a qualitative preliminary analysis and on a mapping of stakeholders active in MMFR charcoal and pole production systems (Quispe Zúñiga et al., 2016), we opted for a snowballing approach (Reed et al., 2009), in which key stakeholders identified other participants. Respondents were of different professional, social and geographical origins and included locals (local leaders, charcoal and pole contractors, ecotourism entrepreneurs); government officials (from resp. the Forestry Department, the Fisheries Department and the Wildlife Department); NGO staff (both in the Matang area and in Kuala Lumpur) and scientists (from universities and from the Forestry Research Institute of Malaysia (FRIM)) as outlined in Table 1. In Q methodology, the participants are the variables, and should allow to establish the existence of factors, hence large numbers of participants are not required to sustain a good Q study (Watts and Stenner, 2012).

4.5. Q sorting

The 48 Q set statements were provided to the participants on separate, numbered cards. The participants were asked to sort the statements on a -3 to $+3$ Likert scale, whereby -3 indicates least agreement and $+3$ strongest agreement. The participants were provided an empty matrix in a near-normal 'forced' distribution, which is an effective way of capturing participants' viewpoints (Watts and Stenner, 2012) and also a common practice in Q sorting (*e.g.* Cuppen et al., 2010; Lansing, 2013). The participants then sorted the statement cards. However deviation from the forced distribution was allowed when a participant had particular difficulty since it makes little difference in the analysis whether or not the forced distribution was adhered to (Brown et al., 2015; Watts and Stenner, 2012). After the Q sorting, a post-sorting interview was performed to understand the participants' viewpoints by focusing on what the most important (typically the most extreme) statements meant to them.

5. Results

5.1. Data analysis: factor extraction and rotation

The data was analyzed with PQmethod software (Schmolck, 2014).

First a correlation matrix was calculated through the inter-correlation of each Q sort with every other Q sort. This correlation is a measure of similarity of viewpoints between Q participants. As Q is a data reduction technique, the correlation matrix is subjected to a factor analysis to reduce the diverse viewpoints to a smaller set of factors that reflect shared ways of thinking (Zanoli et al., 2015). We used centroid factor analysis to extract factors, a widely used approach which is more permissive regarding data exploration (Cuppen et al., 2010; Watts and Stenner, 2012).

Similar Q sorts, in which statements were ranked in a similar way, are identified by PQMethod and grouped into the same factor. Initially, five factors were extracted using the rule of thumb of five factors per 6 or 7 participants ($n = 29$ participants), Watts and Stenner (2012). These five factors were subsequently rotated using Varimax rotation (which maximizes the amount of explained variance while maintaining orthogonal axes), followed by manual rotation for factors 4 and 5. The manual (90°) rotation for factors 4 and 5 then led us to leave out factor 5 as it lost its explanatory power after rotation. Subsequently it also appeared that factor 4 had only one significant loader, which means this factor does not

Table 1
Statements (S) constituting the Q set presented to the respondents.

Statement (S)
1. Mangroves are most important because they provide timber wood, charcoal and fish (nursery).
2. Mangroves are most important because they provide protection against floods and storms.
3. Mangroves are most important because they provide a carbon/CO ₂ sink (they store carbon and hence they are important in mitigating climate change).
4. Management of mangrove forests is key for sustaining the fish/prawn stocks in Matang region.
5. Ecotourism is an important source of income in Matang.
6. Ecotourism is important for educating visitors about Matang mangroves.
7. The revenues generated by economic activities in Matang are benefiting everyone
8. Among the charcoal and pole workers, only tree cutters earn more than minimum wage
9. The water in Matang mangroves is polluted due to industrial activities, palm oil mills and rubber factories inland.
10. Matang mangroves provides the best quality poles in the country.
11. The yield of wood production is declining over the years in Matang.
12. Fish catch is declining over the years in Matang region.
13. The production of blood cockles in Matang region is increasing.
14. The bird population in Matang is declining (especially migrating shorebirds).
15. The demand for charcoal and poles is increasing and causes strong pressure on the mangroves forest.
16. The Working Plans of the Forestry Department are well followed and enforced.
17. The primary objective of management of Matang mangroves is the production of charcoal and poles.
18. Conservation of biodiversity (the diversity in plant & animal life) is important in Matang mangroves.
19. If tradeoffs have to be made, the economic objectives of mangrove management (charcoal, poles) should be a priority.
20. Managing mangroves focusing only on <i>Rhizophora apiculata</i> (bakau minyak) is a good decision, as this is the most interesting tree species to generate charcoal and poles.
21. Matang mangroves proves that exploitation does not have to mean degradation.
22. The management of Matang mangroves is (one of) the best in the world and is a good example for other forests/countries.
23. The tree logging and cutting cycle in Matang is closely related to the natural cycle.
24. The management of Matang mangroves is sustainable from an economic point of view (profit can be maintained year after year).
25. The management of Matang mangroves is sustainable from a social and ecological point of view (quality of environment and quality of people's life can be maintained year after year).
26. Parts of Matang mangrove forest should be kept undisturbed and free of human activity.
27. Matang should be developed as a major national (eco-)tourism destination.
28. The use of satellite images to support the management of Matang mangrove forest is not important.
29. Keeping a mix of managed and unmanaged blocks of forest is necessary to act as a mangrove seed bank for both Matang and other mangrove areas.
30. The existing restricted and protected jungle forests are large enough to act a seed bank for the area.
31. Changing the cutting and logging cycle timing (now: 15-20-30 yrs), is difficult.
32. Planting mangrove trees is not necessary after clear felling.
33. The charcoal industry is strong and healthy in Matang.
34. The contractors have to supply the Forestry Department with a monthly report. This is important for control and enforcement of the Working Plan.
35. The increasing demand of poles for construction has become bigger than the supply.
36. The management plan should be changed to allow different tree species to develop. (Instead of focusing only on <i>Rhizophora apiculata</i> (bakau minyak)).
37. Shrimp culture should be allowed in Matang mangrove forest.
38. Chemicals should be used to eradicate weed (<i>Acrostichum</i> spp.) in the forest.
39. Mangrove protection is an important task for all states in Malaysia (not only Perak).
40. Everyone involved in the management of Matang forest shares a common goal.
41. There are no conflicts between people regarding access to land and natural resources (timber, fish, etc.)
42. The Forestry, the Fisheries Department and the Wildlife Department collaborate efficiently to manage Matang mangrove forest.
43. Local communities and fishermen, as well as NGOs, should be involved in the management of Matang mangroves.
44. Scientific research is necessary to improve the management of Matang mangroves.
45. Tourists visiting Matang should pay a small fee to visit the boardwalk.
46. The involvement of local communities is important for the success of tourism activities.
47. Charcoal workers face health problems when working.
48. Matang mangroves forest creates a lot of jobs.

qualify (Watts and Stenner, 2012) and could make factor interpretation difficult in a later stage. However, we briefly discuss the perspective of factor 4's lone loader in the discussion section as it includes original elements not covered in the three discourses embodied by factor 1–3.

At the end of the extraction and rotation process, three factors remained, together explaining 41% of the study variance (which is slightly above the range of 35–40% variance explanation proposed by Watts and Stenner (2012) and which is in line with e.g. Benitez-Capistros et al. (2016)). The three factor solution is further backed by the Kaiser-Guttman criterion (eigenvalues of each of the three retained factors > 1) and by the minimum of two significantly loading Q sorts per factor at $p < 0.01$ level (calculated using Brown's equation: $x = 2.58 * (1/\sqrt{n})$ with n indicating the number of statements. In our case: $x = 2.58 * (1/\sqrt{48}) = 0.37$).

In Table 2, the Q sorts that 'load' significantly on a particular factor, as well as the factor-defining Q sorts, which load significantly on only one factor are indicated. The defining Q sorts for each

factor exhibit similar viewpoints relative to the issue in question. Factor loadings (squared) give the percentage of the variance explained by each factor for a specific Q sort/participant.

5.2. Data analysis: from factor to factor arrays

The degree of correlation between factors and the weighted average of the loaders' Q sort patterns were used to calculate an ideal-typical Q sort for each factor, the so-called factor array (Table 4). Being a merged average, the factor arrays look like single complete Q sorts.

Although the factors scores correlate significantly (Table 3), Q methodology findings demand an interpretative approach. While the inter-factor correlation may suggest that the three factors are alternative manifestations of a broader discourse (Watts and Stenner, 2012), we opted for the three-discourse solution in Section 5.4, based on the analysis of the respective factor arrays and on the post-sorting interviews.

Table 2
Characteristics of Q participants (Px indicates the participant identification code, used in Section 5).

Category	Number of Q participants (P)
Officials	
Perak Forestry Dept. (P1, P9, P10, P13) P14	5
Perak Wildlife Dept. (P5, P17)	2
Perak Fisheries Dept. (P6, P7, P16)	3
Non-governmental organizations	
Local NGOs (P18, P19)	2
National/international NGOs (P22, P23, P26)	3
Scientists (P24, P25, P27, P28, P29)	5
Others	
Local leaders/representatives (P8, P12, P15)	3
Charcoal & pole contractors (P2, P3, P11)	3
Ecotourism (P4, P20, P21)	3
Total	29

Table 3
Varimax rotated factor matrix with factor loadings (performed in PQMethod); (*) indicates a loading Q-sort at $p < 0.01$ calculated using Brown's equation; X indicates a factor-defining Q sort.

Q sort	Factor 1	Factor 2	Factor 3
1	0.0657	0.0304	0.6582 * X
2	0.5046 * X	0.1368	0.2340
3	0.2416	0.4097 *	0.4946 *
4	0.1924	0.4605 * X	0.2612
5	0.3835*	0.1387	0.4691 *
6	0.1149	0.1982	0.7231 * X
7	0.4968 * X	0.2867	0.3269
8	0.4363*	0.4611 *	0.0868
9	0.2259	0.2004	0.3702 * X
10	0.2196	0.1535	0.6992 * X
11	-0.0692	0.3827	0.5069 *
12	0.0648	-0.0620	-0.0051
13	0.6195 * X	0.1471	0.0104
14	0.3198	0.6047 * X	0.2071
15	0.4320 * X	0.2068	-0.0271
16	0.3551	0.1801	0.4852 * X
17	0.6680 * X	-0.0717	0.3340
18	0.0111	0.5766 * X	0.3632
19	0.3938*	0.3777 *	0.2428
20	0.0445	0.5771 * X	0.2585
21	0.0917	0.6083 * X	0.2570
22	0.4711 * X	0.3066	0.1970
23	-0.2466	0.1416	0.0063
24	0.4360*	0.2370	0.4347 *
25	0.2793	0.2771	0.4873 * X
26	0.4655*	0.6508 *	-0.1496
27	0.2801	0.7485 * X	0.1494
28	0.6025 * X	0.1618	0.1082
29	0.6742*	0.5215 *	0.1217

5.3. Data analysis: from factor arrays to factor interpretations

Interpreting the factors will lead to uncover the viewpoints captured by the factors and shared by the significantly loading participants. Factors are interpreted by: i. inspecting the patterning of items in the factor array, ii. by analyzing the distinguishing statements for each factor, and iii. by analyzing the post-sorting interviews (especially the interviews of participants whose Q sorts significantly (at $p < 0.01$) load on that factor. The factors were synthesized in coherent narratives as suggested by Watts and Stenner (2012) and by Rastogi et al. (2013).

5.4. Discourses on the management of MMFR, as identified based on the Q methodology

The factor arrays of factor 1, 2 and 3 (i.e. the ideal-typical sorts

describing each factor), representing discourse 1, 2 and 3 respectively, are presented in Table 5. The second row represents the Likert Scale by which participants had to sort statements. Statements are listed under each rating according to how much the participants agreed (ranked +1 to +3), disagreed (ranked -1 to -3) or did not express a preference (ranked 0) for factor 1, 2 and 3 respectively.

5.4.1. Discourse 1: Optimization – keep up the good work, but keep improving

Factor 1 explains 14% of the study variance. There are 7 factor-defining participants that are significantly associated with this factor alone. These participants constitute a diverse group of charcoal contractors, fishermen, NGO staff, academics, Forestry & Wildlife Department officials.

The discourse embodied by factor 1 carries the idea that while continuation of economic activities and livelihood provision from the current management regime -i.e. mainly focused on charcoal and poles production-is a key pillar (S22; S24), the conservation of biodiversity (S18), ecotourism & education (S6, S27) and storm protection (S2), are also highly valued functions. Strengthening this multifunctional perspective, participants defining factor 1 consider that the primary objective of the management of MMFR should not be focused on charcoal and pole production alone (S17). Some issues prevent further conservation of biodiversity and development of ecotourism & education. Increased tree diversity to increase biodiversity in MMFR would result in a loss of economic competitiveness (S36), since *Rhizophora apiculata* is considered the best species for charcoal and pole production (P2, P7). Lack of funding for ecotourism and lack of regulation of tourist guiding impedes further development of ecotourism & education in MMFR (P13). Regarding ecotourism, adherents of discourse 1 are cautious: P2 warns not to overestimate the impact of ecotourism: “Concerning ecotourism incomes, the inflation rate is higher than the increase in income, so ecotourism is a side income to assist people here”. This is supported by P7, a fisherman: “Ecotourism is booming, but we are not relying on it.” For some (P22) Ecotourism is nothing more than “an incidental effect”. Regarding the production of physical goods, P13 expects scientific research to help diversify the offer of products derived from MMFR (not only charcoal and poles). This wish for diversification reflects the need for more income-generating jobs in MMFR, as stated by P7: “In the wood industry (...) jobs (e.g. charcoal ash sorter, log bearer etc.), income is still not enough. They need another source of income”.

Active management, including replanting after clear-felling (S32) and physical eradication of weeds (S38), is perceived as a requirement to maintain the mangrove's highly valued economic sustainability (S24), or as stated by P22: “This is necessary for sustainability. The rule of thumb is: cut one tree, plant five”. Moreover, replanting allows trees to be evenly spread and grouped according to their age, which facilitates access and cutting (P7). Scientific input (S44) to improve the management is welcomed, although there is not much enthusiasm to radically change the current management regime (S31, S36) (e.g. P13: “It is difficult to change the plan because it will encounter protest from the workers and contractors”).

Factor 1 is often most critical with regard to the different actors involved and their responsibility compared to the other factors (S16, S41, S42). There is an acknowledgement of the occurrence of conflicts among stakeholders (S41), e.g. with regard to cockle production: P13: “The access to the waterways is impeded due to the construction of cockle cages”, which according to P22, is an example of a broader conflict on resources. “The area is a productive land - which means money can be earned – which also means more conflict.” There is no strong agreement with regard to the incomplete

that the yield of wood production is declining due to a decrease of the areas allocated to contractors by the government, and P14 claims to observe a decrease of birds in the area but does not think this is attributable to the current management.

5.4.2. Discourse 2: Change for the better – ecotourism & participatory management for sustainability

Factor 2 explains 14% of the study variance. There are 6 factor-defining participants that are significantly associated with this factor alone. These include all interviewed ecotourism entrepreneurs (all significantly loading on this factor), as well as academics, one NGO-representative and a Forestry Department respondent.

Like discourse 1, the discourse embodied by factor 2 promotes a more multi-functional management and indicates disagreement surfacing about the focus of the management actions. However, there is a stronger emphasis on ecotourism as a source of income (S5, S27) as well as on the carbon sink function (S3) compared to factor 1. E.g. P14: “If we just rely on the charcoal industry, it might not be able to continue. Licenses are getting high in number and it may no longer be sustainable. Thus ecotourism is a good alternative.” P21: “Mangroves are important for our survival. The forest provides oxygen and absorbs carbon. The forest also mitigates global warming, and can catch up with sea level rise through sedimentation.” Moreover several participant quotes suggest a wish for increased biodiversity conservation (S18). E.g. P27: “Can other species grow in that zone?” P21: “In MMFR, monoculture is practiced. I think this is not good for the forest. (...) Thus we need research in this area so as to promote also biodiversity in managing the mangrove reserve”. However, there is also a recognition that to ensure economic gain from silviculture (charcoal and pole production) *Rhizophora apiculata* is the preferred species (S36). Research is expected to help diversify the provision of products derived from MMFR (beyond charcoal and poles) (S44).

As for factor 1, active management, including replanting after clear-felling (S32) and physical eradication of weeds (S38), is perceived as a requirement to maintain the mangrove's valued current production system. Again scientific input (S44) (such as satellite imagery; S28) to improve the management is welcomed. P4 states: “These images are very useful in monitoring the area, as Matang is vast. It is also very important for navigation and guides me with regard to the accessibility of channels during the boat tour”. However, there is not much enthusiasm to radically change the current management regime (S31, S36).

Factor 2 stresses the lack of active involvement of non-state actors in the area's management (S43, S46), and does so more strongly than factor 1. A stronger involvement of non-state actors is seen as a way to generate new effective ideas as it would help create a stronger sense of ownership and support. P27 states: “it is important to convince local communities of the importance of the management” Moreover, it would be positive for practical reasons, as stated by P14: “Everyone should be involved in replanting the seeds (...); ‘mother trees’ are very low in number. People should be empowered to conserve it by themselves. Rather than just replanting, a program should be developed to educate people on how to find seeds in a natural set-up and plant it themselves.” Also, there is a more critical view towards the current management dominated by officials, by P21: “There is no efficient collaboration (S42). Every department just fulfills its own task. They follow their own rules. They just do whatever is in their jurisdiction. Sometimes they will just say “It is not our work. It's their job”; and bureaucracy is criticized, e.g. by P20: “Bureaucracy ignores the interest of the people”.

The general quality of the current mangrove management regime (S9, S11, S16, S21, S25) is emphasized by factor 2. The participants loading on factor 2 state that everyone in MMFR shares a

common goal (S40) – expressed by P4 as “to see the area as it is in the next 100 years. It is possible because the people in the area are connected to the mangroves culturally and they consider it as heritage.” However there are important caveats in this discourse, which is more critical than the positive stance described above may initially lead to believe. The claim of MMFR being the best managed mangrove in the world (S22) is dismissed in contrast with factor 1 and factor 3. This is reflected in the pertinence of different threats to MMFR identified by the participants. These threats include illegal logging, as stated by P18: “If the illegal loggers will not be stopped, how can we make sure that MMFR mangrove will exist in 2115?”; continuing shrimp culture, which is widely criticized (S37) for example by P20: “Shrimp culture requires clearing of mangroves and causes pollution (...) The ponds are used for only five years and then abandoned. As for the dead soil, it will take 30 years to replant on it again” and policy including biased policy decision (P21), easy de-gazettement of gazetted areas (P27) and bureaucracy which ignores the interest of people (P20). The wish for diversification and the criticisms thus indicate a shared concern regarding the long-term sustainability of the current situation, which is still considered to be satisfactory but endangered.

5.4.3. Discourse 3: Continuity - business as usual is the way to go

Factor 3 explains 13% of the study variance. There are six factor-defining participants that are significantly associated with this factor alone. The supporters of this discourse are mainly found among officials from the Forestry, Wildlife and Fisheries Department as well as among researchers associated with government-funded agencies. Hence this discourse can also be termed the ‘official’ discourse.

The support for a more multi-functional management of MMFR appears in the discourses embedded in factors 1, 2 as well as 3. However in factor 3, the focus is on the mangrove's observed function as a protective barrier against floods and storms -as in factor 1- (S2) and on its high potential as an ecotourism and education site (S27, S6) in addition to its main function of charcoal and pole production (S1, S17, S33). P1 states: “The primary objective of the management is charcoal and pole production, because the economy of the area is based on these two sectors”. Income from ecotourism is seen as an addition to the income derived from the main economic activities (i.e. charcoal and pole production) rather than a possible alternative to them in the future as is supported by factor 2. For example P6 states: “Fish farms and practices are tourist attractions itself.” P10 states: “The attraction of dolphin watching is under strict control, and the rules are willingly followed by the boat drivers because it is a source of income for them.” Moreover (eco-) tourism activities and (eco-)tourism-based education should also focus on current main economic activities, including fisheries, charcoal and pole production rather than only focusing on nature conservation and mangrove ecology as in factor 1 and 2. P6 states: “Education should be about forestry, about the importance of the mangroves, about the charcoal industry (...) and fisheries, the catch technique, the cockle culture, processing etc.” Shrimp culture (S37) is not emerging as a statement eliciting strong reactions (unlike in factors 1 and 2 (e.g. P2, P20)).

The current active management regime -including replanting after clear-felling (S32) and physically eradicating weeds (S38)- is perceived as a requirement. P6 states: “It is necessary to clear-fell and replant otherwise the cleared area will become a bare land. It is some sort of routine.” However, this discourse does not include openness to -minor-changes in the current management approach. The statement on the necessity of research to improve management in MMFR (S44) does not emerge while it is rated +3 in factors 1 and 2. Moreover, P24 states: “If you change the logging cycle (S31), you destroy the mangrove system.”

Reluctance to change is also reflected in the appreciation of the roles of the currently dominant management actors. The discourse emphasizes the good collaboration between the three state Departments (Forestry, Wildlife and Fisheries) (S42), while this does not emerge in factor 2 and is not agreed upon (rated –1) in factor 1. This is exemplified by a quote by P1: “the Forestry, Fisheries, and Wildlife Departments are collaborating efficiently because all of them share a common goal which is to make the management much better. Similarly P16 stresses that there are no threats to MMFR “because the agencies are making sure that the mangrove resources & services will be sustained.” P10 states: “Forestry and Wildlife Department staff can report to the Fisheries Department if they spot some poachers.” P10 further mentions the role of inter-departmental collaboration for monitoring purposes. In contrast to factor 1, supporters of factor 3 claim there are no conflicts over resources in MMFR (S41). In contrast to factor 1 and 2, there is some contradiction in the statements regarding the involvement of non-state actors (S43). P24 expresses reluctance regarding more involvement of non-state actors: “If you involve too many people, you get troubles.” P6 has a different opinion and sees advantages in involving local communities in management: “Local villagers should play a role (...). Forest management should be improved through local participation.”

The discourse embodied by factor 3 strongly favors the current management regime, which is presented as one of the best in the world and should serve as an example for mangrove protection to other states when they take their responsibility to protect mangroves (S22, S39). The current management regime is said to create a lot of jobs (S48) with earnings above minimum wage (S39). The existence of problems in MMFR is also refuted: the fish catch is not declining (S12), the demand for charcoal and poles is not increasing so much as to cause pressure on the forest (S15), bird populations are not declining (S14) nor is the yield of wood production (S11), and charcoal workers face no health problems (S47). The last assertion is illustrated by P1: “Every day, the –charcoal- people I meet and deal with are still strong and healthy”. P6 (a fisherman), states that any pollution problems that may arise in MMFR are caused by inland activities (which tends to be at least in part supported by Ghaderpour et al., 2014) but also underpins the view of MMFR as an ‘island’: “Fisheries activities are aquatic in nature, so it will not affect the mangroves. No need to decrease the fishing pressure and shrimp culture practices because the ones that are causing the pressure are inland activities.” Similarly, on the management approach P1 states: “The yield of wood production is still stable. In fact, the Forestry Department is continuously opening 1000 hectares per year (for exploitation by contractors). These openings suggest that there is no decline in wood production otherwise they would have conserved it.”

5.4.4. Consensus among discourses

Statements 4, 6, 29 and 34 do not distinguish between any pair of factors at $p > 0.05$, which indicates that there is a consensus among the adherents of the three discourses regarding these statements, which include the importance of the mangrove forest for sustaining fish and prawn stocks (S4), the educational value of ecotourism (S6) as statements where positive stances are consistent, while neutral to negative values (0 and –1) were granted to S29 (mix of managed and unmanaged forest patches to act as seed bank). Neutral values (0) were consistently granted to S34 (on the use of monthly reporting by contractors to the Forestry Department). Neutral values do not necessarily mean that respondents had no opinion on the matter, e.g. the mix of managed and unmanaged patches was perceived by some as entailing too many unknowns (e.g. would this mean keep, modify or abandon the current zonation of MMFR?).

6. Discussion

6.1. Understanding discourses as a step towards socio-ecological sustainability

Unlike the findings of some Q studies regarding environmental resource management (e.g. Lansing, 2013; Rastogi et al., 2013), there was no obvious polarization among the identified discourses. This could be due to the fact that the century-old active management of MMFR for economic purposes is considered a given to which only minor changes are deemed realistic. This relative consensus on the desirability of a continued management of MMFR should not lead us to ignore disagreements which surfaced during the Q sorting process and during the interviews.

Supporters and constitutive elements of the optimization discourse are expected to associate most easily with those of both other discourses. The optimization discourse supporters' stances on the aims, approaches and implementation of the actual and –variations of-desirable management regimes are broadly compatible with both the conservative ‘business as usual’ discourse, and the mildly reformist ‘change for the better’ discourse.

Despite the diverse viewpoints, all discourses seem to be situated along a continuum. The entire continuum is characterized by a dominance of utilitarian/instrumental values reflecting the usefulness of nature for humans, whereas the intrinsic value of nature is hardly mentioned at all (despite being present in some of the presented statements (e.g. in S18 and S19)). It is remarkable that one of the main debates fueling- but also paralyzing-natural resource management conflicts worldwide (Sandbrook et al., 2010) is almost absent for MMFR in its most vehement form. However one respondent (P23), not loading on any of the three identified discourses, stands out with an original -and seemingly minority-stressing the fact the biodiversity conservation should definitely be the main objective in managing MMFR, and highlighting the uneven distribution of benefits from the current management and charcoal and pole-dominated production systems.

Acknowledging the conservative and even defensive stances embodied in the business as usual discourse however, there is a risk of latent conflicts becoming more prominent in the future. Currently the business as usual discourse dominates as MMFR is still managed in a top-down fashion. Given the proven track record of the currently enforced long-lasting approach measured through at least a range of criteria (silvicultural sustainability in terms of wood yield for charcoal and pole production (Goessens et al., 2014), maintenance of the area of mangrove forest (Ibharim et al., 2015), carbon storage (Ammar et al., 2014), biodiversity protection (Birdlife, 2004)), one can at least understand that there is no shared sense of urgency regarding the need for change. The ‘why change a management approach that works?’-stance most actively voiced by the official actors in the third discourse is understandable in the short-run but risky at medium- and long-term horizons.

Prior to the present study, alternative discourses on MMFR had not been identified systematically. These discourses may enrich and improve the current management approach in a constructive and non-conflictual setting. Moreover the non-revolutionary and reformist character of these alternative discourses provide opportunities for dialogue, mutual learning and experimenting, e.g. with regard to the more active involvement of non-state actors in the management approach and/or with regard to a gradual evolution towards a multifunctional, multiple resources management regime in MMFR. Elements of the most recent Matang Working Plan (Ariffin and Mustafa, 2013) hint at the fact that the multiple functions of MMFR mangroves are increasingly recognized in the business as usual discourse, which is in line with recent literature

on mangrove functions (Jusoff and Taha, 2008; Mukherjee et al., 2014). The scale of MMFR would make it possible to design and implement a series of management regimes ranging from low to high-intensity uses (as proposed in the framework of van Audenhoven et al., 2015 for Java, Indonesia). As discourses are in no way static, discursive shifts and changing mindsets may facilitate the search for shared management approaches.

MMFR could be an example of management reform that moves beyond the conservation versus development controversy (Buscher and Whande, 2007; Mace, 2014) – especially if the perception of the value of the area (which is an Important Bird Area (IBA)) for biodiversity conservation gains momentum (e.g. MMFR is one of the last places in peninsular Malaysia where Lesser Adjutants (*Leptopilos javanicus*) and Milky Storks (*Mycteria cinerea*) breed) (Birdlife, 2004). There is a role for scientists to provide decision-makers and other stakeholders the available information regarding the management options that could provide ‘points of connection’ between the adherents of the three discourses (Witter, 2013). This is not to say that tradeoffs or conflicts will not happen, but the realization of the existence of alternative discourses combined with a detailed description of their constitutive elements allows for a pragmatic approach of searching for common ground.

For now, the power of the supporters of the three discourses in MMFR is unevenly distributed. The power of the ‘business as usual’ discourse is enhanced through state authority, and some of its supporters expressed a rigid and/or defensive stance which may cause tensions and may hamper the accommodation of a broader spectrum of viewpoints. Notwithstanding this caveat there is a unique window of opportunity for the adherents to the dominant discourse to engage with the other stakeholders in MMFR. In doing so, points of connection between the various stakeholders will be forged, which has the potential to further improve the sustainability of MMFR as a socio-ecological system in which resource systems and their units interact with governance systems and their users (Ostrom, 2009).

6.2. Limitations of the Q methodology

While the use of Q methodology allowed us to map and characterize the discourses regarding the management of Matang, the methodology involves personal interviews and probes for the participants’ subjective viewpoints on potentially sensitive issues, which brings with it a few downsides: i. During the stakeholder identification stage at the start of the Q process, the snowballing approach soon led us to fishermen, pole cutters and charcoal kiln operators (as identified by Quispe Zúñiga et al., 2016). However interviewing them and making them use the Q sorting template proved difficult to impossible because of social, educational and cultural barriers. Other methods (such as focus groups, face-to-face interviews, participatory mapping or the design of rich pictures (Bell and Morse, 2008)) would be needed to fully include these participants’ viewpoints too. Despite this we explicitly aimed at achieving discursive representation as outlined in Section 4.4. ii. The will of some respondents to ‘please’ the research team was apparent in some instances. This highlights the need to relentlessly clarify the aim of the exercise which is to map subjectivity – hence there are no right or wrong answers. iii. Designing and administering a Q is a work of progressing insight, which means that with hindsight, some statements could have been formulated differently and the forced distribution provided to the participants may have included more scoring options (by way of a broader Likert scale)).

These findings however do not reduce the suitability of Q in exploring and explaining patterns of subjectivities among stakeholders and in providing building blocks for a sustainable management of MMFR.

7. Conclusion

This study shows that the management of MMFR is viewed in at least three distinctive structured clusters of viewpoints, which we term discourses. The ‘optimization’, ‘change for the better’ and ‘business as usual’ discourses all contain original elements but also exhibit similarities which we term ‘points of connection’.

Discourse mapping aims at gaining a better understanding of people’s perceptions about an issue, and Q methodology proved to be a suitable approach to map discourses on mangrove management in MMFR, by combining statistical analysis (factor analysis) and interpretation. The existence of different normative viewpoints on natural resource management and conservation is now widely recognized (Mace, 2014) and this study has contextualized this diversity at the local level. The combination of a century-old management regime in MMFR and the rapidly changing socio-economic and ecological landscape in Malaysia (which obtained Middle Income Country (MIC) status in 1992 (Woo, 2009) and is now an upper-middle income country (World Bank, 2011)) provides an interesting case.

Without abandoning the strengths of the current management regime in MMFR, the emergence of new internal and external risks as well as the identification of alternative viewpoints and insights on e.g. the role of civil society in natural resources management, on the valuation of ecosystem services and on regional and global biodiversity loss, provide an opportunity to reflect on the future of natural resource management by a constructive confrontation of a diversity of discourses.

Inspiration for the objectives, the management approach and its implementation, originating from the various discourses can be channeled into existing sustainability assessment frameworks, such as Ostrom (2009). The three discourses carry diverse views on criteria regarding i. resource systems (e.g. the productivity and predictability of the mangrove forests in terms of wood production), ii. resource units – in our case mangrove trees, in particular *Rhizophora apiculata* – (e.g. mobility (mangrove propagule dispersal), spatial and temporal distribution, economic value), iii. users (their numbers and socio-economic characteristics); and iv. governance systems (e.g. collective choice rules, monitoring & sanctioning processes). The three discourses (and their ‘hybrids’) provide sources of inspiration and knowledge on how to embody and assess the sustainability of the Matang mangroves as a socio-ecological system. While further research is needed on the perceptions of local communities and workers, and on the ecological sustainability of the Matang mangroves, this study provides new insights that feed the reflection on the future of natural resources management in a long-managed but still not fully scientifically explored socio-ecosystem.

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