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Title: Applying stakeholder Delphi techniques for planning sustainable use of aquatic resources: experiences from upland China, India and Vietnam

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Abstract

The HighARCS (Highland Aquatic Resources Conservation and Sustainable Development) project was a participatory research effort to map and better understand the patterns of resource use and livelihoods of communities who utilize highland aquatic resources in five sites across China, India and Vietnam. The purpose of this paper is to give an account of how the stakeholder Delphi method was adapted and applied to support the participatory integrated action planning for sustainable use of aquatic resources facilitated within the HighARCS project. An account of the steps taken and results recorded is given for each of the five sites. Methodological challenges are discussed. It is illustrated how the method provides opportunities for systematically pursuing joint interaction with all concerned stakeholders in an iterative fashion, compatible with a joint learning approach to action planning. It was found that the tool was not as effective as expected in creating stakeholder consensus where issues had already been the object of previous research and discussions with local stakeholders or where asymmetrical power relations between stakeholder groups constrained the reliability of responses given by stakeholder Delphi panel members. But the HighARCS experience suggests that the stakeholder Delphi remains useful as a decision-making device for the selection of appropriate action when applied in combination with action plan feasibility assessment tools. The application of the stakeholder Delphi requires

the presence of multidisciplinary and facilitating skills and competences within the implementing teams which should be considered before deciding to include a stakeholder Delphi as a decision-making tool.

1. Introduction

The vast range of the Himalayas and adjacent mountainous areas in South East Asia are the source of water feeding some of the most populated river basins in the world (ICIMOD, 2010). They are characterized by a highly diverse and still not fully catalogued fauna and flora (Allen et al., 2010, 2012). Ecosystems that depend on the aquatic resources from these uplands provide a wide range of services to the population (drinking water; irrigation; energy; transport; food; waste recipient; recreation) but are also associated with risks from flooding and water-borne diseases. The uses of aquatic resources in these areas are many, and users are often strongly competing for access and control over them.

[Figure 1]

As populations are growing and economies expanding, pressures on aquatic resources are rising (MEA, 2005; Russi et al., 2013). Developing judicious and efficient environmental governance and management systems for these resources is becoming more and more important (Hoffmann et al., 2010; CBD, 2013; Pandit, 2013). But this is by no means an easy challenge. Not only are users in strong competition for access and control, the governance systems are organized in a multitude of national, provincial or local institutions, authoritative bodies and local communities with partial responsibilities, unclear boundaries of jurisdiction, and incomplete or very specialized knowledge of the issues at stake (Dudgeon, 2006; Atapattu et al., 2011; Finlayson et al., 2013). There is an increasing need for the development of recognized and efficient social forums where relevant knowledge about environmental issues can be shared, debated and mediated in view of the establishment of management rules and practices which have the support and are perceived as being reasonable and legitimate by most of the concerned stakeholder groups (ICIMOD, 2010; Boelee et al., 2013).

The HighARCS (Highland Aquatic Resources Conservation and Sustainable Development) project was a participatory research effort (2009–2013) to map and better understand the patterns of resource use and livelihoods of communities who utilize highland aquatic resources in five sites across China, India and Vietnam.[1] The research approach was participatory and integrated as defined by Springate-Baginski et al. (2009), where biodiversity, livelihoods, economics, policy and conflicts are assessed jointly for particular wetlands, rather than as separate policy and planning sectors. The purpose of this paper is to give an account of how the stakeholder Delphi method was adapted and applied to support the participatory integrated action planning facilitated within the HighARCS project.

2. Method

The stakeholder Delphi approach can facilitate the interactive participation of varied and conceivably hierarchical and antagonistic stakeholder groups and an assumption is made that their knowledge and opinions are valid inputs to research in an inexact research area (Bunting, 2010). The stakeholder Delphi technique is particularly appropriate when decision-making is required in a political or emotional environment, or when the decisions affect strong factions with opposing agendas and objectives. It is also considered good for giving equal attention to minority view points. A distinction is made between the ‘‘classical Delphi’’, where only subject-matter experts are involved as panel members, and the ‘‘stakeholder Delphi’’, where experts as well as local authorities and other stakeholders are included. The stakeholder Delphi process can be divided into a sequence of activities and rounds, with 12 steps being required in a typical assessment involving three rounds (Fig. 1).[2]

Once the rationale and main questions have been decided (steps 1 and 2), the next stage in a stakeholder Delphi study is to undertake stakeholder mapping (step 3) to identify relevant stakeholder groups to be included. It also requires an assessment of which statistical tests are appropriate to sufficiently characterize the responses.

[1] For more information on the HighARCS project, please refer to www.wraptoolkit.org.

[2] For a more detailed explanation of the steps, please refer to Bunting (2010).

Once these technical issues have been decided on, the stakeholder Delphi runs over 2–3 rounds. The first round is a series of open questions pertinent to the issue under consideration presented to the panel members (stakeholders). Responses received from the panel members are then grouped into a reduced number of representative statements about the issue, its importance, causes, and solutions. In the second round, these statements are presented to the panel members with their frequency of response in round 1. The panel members are asked to rate their level of agreement or disagreement with the statement on a scale usually from 1 (total disagreement) to 10 (total agreement). Results from round 2 are statistically analyzed for concordance around the median score.

If the results from the second round show a strong or unusually strong agreement among the panel members, the process is stopped. If not, responses are returned to the panel including information on the median score from round 2. Panel members are asked if they can agree with the median score or to specify a different score. Furthermore, if this score lies outside the interquartile range they are requested to provide further explanation. The results from round 3 are analyzed statistically for concordance, using the same statistical tests as in round 2. It is expected that the degree of agreement will increase from round 2 to round 3.

The specific choice of statistical tests can vary. In this article two non-parametric tests, Friedman's X^2_r test, in combination with Kendall's W test of concordance are used. Friedman's test is used to assess the degree to which ratings assigned by participants share a common distribution. Confidence in the degree of agreement can be assessed with Kendall's coefficient of concordance (W). This measure of rank convergence, ranging from 0 to 1 is recommended for interpreting data from Delphi investigations, providing a measure concerning the degree of consensus achieved and level of confidence in mean ordinal ranks. Outcomes are ranging from very weak (Kendall's W between 0.0 and 0.1), weak (0.1–0.3), moderate (0.3–0.5), strong (0.5–0.7) to very strong (0.7–1.0). (Schmidt, 1997). The results are given with the indication of the p-value. Results are considered statistically significant if the p-value is below 0.05.

The Delphi method is known to have some issues of concern regarding for example the identification and selection of experts, the organization of feedback, as well as the definition and measurement of agreement (Meijering et al., 2013). The issue of its deficient application has also been raised (Landeta, 2006). Some of these concerns have been reported also in relation to experiences applying the stakeholder Delphi (Geist, 2010). But the limitations, challenges and solutions to methodological weaknesses of the stakeholder Delphi technique need to be further documented and understood.

2.1. Application at the study sites

Stakeholder Delphi studies were undertaken at each site involving representatives from all stakeholder groups, including distinctive gender and age groups, to better characterize constraints and conflicts, and build consensus concerning opportunities for better conservation and management of highland aquatic resources, opportunities for livelihoods enhancement and sustaining ecosystem services.

The responsible in-country teams structured their questions differently according to the specific situation of the given site, the action planning approach being followed, and the experience and research profile of the team. As a common framework, the teams were invited to consider structuring their questions according to:

- a factorial framework built around the STEPS (social, technical, environmental, political and sustainability) issues;
- a problem-cause-impact-solutions framework organized around a process analysis of Drivers-Pressures-State-Impacts-Responses (DPSIR model);
- or a combination of both.

A particular methodological issue was encountered concerning the open-ended questions for round 1. In most cases the stakeholder Delphi exercise commenced after the project had carried out surveys, stakeholder meetings, focused group meetings, and household interviews touching upon many of the issues which would otherwise have been left open for the stakeholder Delphi panel members to formulate or articulate their responses

independently in round 1. Some of the teams therefore already had stakeholder-driven claims and statements to include in a scoring procedure during round 1. Although the method normally presumes such statements emerge as a result of round 1, it may have been regarded as a retrograde step by panel members if their past contributions had not been acknowledged and acted upon in round 1.

2.2. Stakeholder mapping and data collection approach

Stakeholder mapping used to identify the relevant stakeholder groups to be included in the panel was based on the contacts made and data collected earlier on institutions and governance systems (Lund, 2011); on stakeholder evaluations of ecosystem services at the sites (IUCN, 2011); as well as general information compiled as part of the situational analysis for each site (Luo et al., 2010; Kundu et al., 2010; Ray et al., 2010; Tien et al., 2010). Wherever feasible, a number of 3–4 respondents were included from each stakeholder category. As to the choice of specific government officers to be invited onto the panel, the Indian and Chinese teams approached the officers as they deemed appropriate or on the basis of who was available. The Vietnamese team approached the leading officers at the respective provincial and local levels and invited them to either participate themselves or to assign other staff members as appropriate. In all sites, the number of members from various branches and levels of the local and provincial authorities constituted more than half the panel.

Briefing of the panel members is a very important aspect of the data collection strategy in a stakeholder Delphi. All teams used the opportunity of stakeholder meetings planned for the project to present findings and discuss the state of the aquatic resources as a briefing method. Panel members were identified among the participants, and the stakeholder Delphi questions explained immediately after the end of the meetings. In some cases responses were collected at the meeting venue on the same day. In other cases, the HighARCS team went subsequently to collect the responses directly from the panel members at their work place. Non-professional panel members (village people, fishers, students) were contacted differently. In China, they were assisted in completing the exercise by the research team or master students in a form resembling personal interviews. In Vietnam, a mixture of focus

group discussions and personal interviews was used. The personal interview style was also used in Nainital, whereas in the Buxa site the focus group discussion method was used.

3. Procedures and results by site

When reporting the findings in view of making cross-site comparisons, it is important to note that although the same basic stakeholder Delphi procedure described above was followed at all five sites, there were some differences in the trajectories of the preceding research processes from one site to another. This context is briefly presented before reporting on the actual stakeholder Delphi process and outcomes for the five sites.

3.1. Shaoguan, China

At the China site, the stakeholder Delphi study was done to facilitate the joint final assessment of the wetlands management situation and issues to be targeted in action plans. Prior to the stakeholder Delphi study, the ecosystem services provided from the wetland of the Beijiang River system had been explored as a part of other research activities undertaken to facilitate biodiversity, livelihoods and policy assessments.

The assessment of ecosystem services was followed by a stakeholder Delphi study on policy responses to the environmental situation of the aquatic ecosystems in the area (restrictions and incentives) (Baoguo et al., 2011). The first round of stakeholder Delphi interviews was conducted in May 2010, the second round in July 2010, and the third round from early October 2010. A total of 47 panel members were selected from the three major stakeholder groups: Government officers (17), company leaders (12), and individual fishers and farmers (34).

The initial open questions for round 1 were extracted from the results produced by the ecosystem services exercise and stakeholder meetings. They were structured into two main sections:

A. importance of legal measures and policies related to environmental protection,
B. importance of legal measures and policies related to fishers' livelihoods to be considered in the near future.

The Chinese team's approach to the stakeholder Delphi exercise went straight for the opinions of participants on the policy and governance responses to conservation and livelihood issues identified during previous research. It was found that stakeholders prioritized measures of industrial pollution control, sand mining control, medical care for fishers, provision of maintenance grant for the poorest, oil (fuel) subsidies for fishing boats, solving the housing problems of the fishers' families, and getting compensation from the hydropower stations for the reduction of the fish resources (Lund, 2013, p. 9).

The Chinese team went through 3 rounds of the stakeholder Delphi (Table 1). The Kendall's W and Friedman's X tests were not performed by the Chinese team initially. The team used an analysis of variance (ANOVA) test to analyze the outcomes, as they were interested in understanding the differences between stakeholder groups (Luo and Liu, 2012). For cross-site comparative reasons, Friedman's X and Kendall's W tests were run subsequently on the Chinese data. The results show significant differences between scores in all cases, and overall consensus to be low to moderately low. It should be noted that round 1 in this case constituted what would normally be round 2, i.e., the round where specific proposals are rated by the panel members, as all the issues had already been explored with the stakeholders and the authorities during previous research activities. This approach may have had implications with regards expected consensus-building as part of the stakeholder Delphi process and views and opinions may already have been modified or entrenched.

[Table 1]

The Friedman's X test statistic is highly significant in all cases (i.e., there are significant differences between scores in all cases). But overall consensus is low to moderately low. There is greater consensus for environmental policy issues compared to livelihood questions. There is also a noticeable increase in consensus from round 1 to 2 and a slight further increase from round 2 to 3. Notably consensus on livelihoods issues increased for round 3. The data do not allow conclusions to be drawn on how the individual panel members have been influenced between rounds as many of them were not the same. What can be said is that the level of concordance increased slightly from round 1 to round 3.

3.2. Buxa, West Bengal, India

Participants in the stakeholder Delphi panel in Buxa included community members, members of the Panchayat (village council); local (including district) and state level government officers, members of civil society and self-help groups. In all 14 stakeholders were identified. Issues in the questionnaire for round 1 pertained to general environmental conditions, extent of aquatic resources use, factors contributing to degradation, policy adequacy/inadequacy, and effectiveness of current environmental policy, economic, social and environmental benefits, threats and potential measures. As some of these questions dealing with the state of the resources and the need for action had already been analyzed with the stakeholders earlier, the round 1 questionnaire had a section for the panel to rate predetermined responses to these questions (Section1: General information), whereas subsequent sections on potential problems and threats (Section 2) and other issues related to highland aquatic resources (Section 3) were kept as open questions. The detailed study can be found in Mishra and Ray (2012).

Responses from Buxa are summarized in Table 2. All the respondents regarded the aquatic resources in Buxa as satisfactory, ranging from acceptable to quite plentiful. Also the extent of pressure on the aquatic resources was considered to be decreasing. Regarding the need for policy changes to conserve aquatic biodiversity the respondents did not indicate a strong need for this as the current provisions are adequate. There is, however, a lack of awareness due to non-availability of relevant information. At the same time, it was recorded that people feel that the present policy regime (set by the location within a Tiger Reserve under the authority of the Forest Department) is not effective enough in ensuring the conservation of aquatic resources that could safeguard economic, social and environmental benefits.

Considering potential problems and threats to aquatic resources, natural calamities (floods), soil erosion, deforestation, pollution through sewerage and poisoning of the river for fishing were mentioned, as well as ‘‘governance inadequacy’’ and lack of infrastructural support (Section 3: Other issues). On these issues, the statistical tests showed a weak concordance of scores (Section 2), and moderate concordance of scores (Section 3) respectively in round 2.

In round 3, contrary to expectations, the level of concordance diminished to ‘‘weak’’ for Section 2 and to ‘‘very low’’ for Section 3. However, as the p-value for Section 3, round 3, increased above the threshold level of p 6 0.05, it was concluded that there was no statistical difference in the scores on the statements in this section.

Concerning stakeholders views to mitigation/solutions (Section 4) round 2 responses showed a moderate degree of concordance, but decreased to ‘‘very weak’’ in round 3. Again, as the p-value considerably passed the threshold level for Section 4 in round 3, it was concluded that there was no statistically significant evidence of consensus (or lack of same) for this section in round 3.

Although the statistical tests do not confirm that opinions diverged significantly more among stakeholders from round 2 to round 3 for Sections II, III and IV at the singular section level, this was clearly the case at the aggregate level of all sections. As an interpretation it could therefore be justified to accept the result as expressing increased discordance. This interpretation is supported by the members of the CDHI team in Buxa, who perceived the development of greater disagreement from round 2 to round 3. Reasons why opinions grew further apart as stakeholders were exposed to the opinions of others may partly be explained by the fact that the local environment and the livelihood situation of the communities living in the Tiger Reserve is considered a sensitive issue and that respondents in the first round according to the CDHI facilitators may not have felt confident enough to disclose their actual (divergent) feelings (Mishra and Ray, 2012).

[Table 2]

3.3. Nainital, Uttarakhand, India

The Nainital team identified 13 relevant stakeholder groups to include in the exercise: boatmen, fishermen, hotel/resort owners and restaurant owners, Irrigational Department, Cold Water Fisheries Department, National Lake Region Special Area Development Authority, Jal Sansthan (water provision department), tourists, small shops around the lake, schools- and college teachers, students, farmers and the Nainital Nagar Palika Parishad (local municipality).

A methodological difficulty was the fact that the same stakeholder representatives were not available to participate in all three phases. Therefore it was agreed to run the Delphi with some respondents from these groups being replaced by new ones between rounds, seeing them as randomly selected representatives of the particular stakeholder group. Interpretations of the effectiveness of the stakeholder Delphi method in terms of facilitating a consensus-building process among the same group of stakeholders therefore must be done with caution.

The team asked (1) how the local environment has changed over time, (2) how the livelihoods depend on biodiversity, (3) what stakeholders understood about the interaction between people and the biodiversity of the lakes, (4) about local perceptions of aquatic biodiversity of the lakes, (5) about awareness of conservation measures to protect the biodiversity of the lake, (6) for suggestions on how the biodiversity of the lakes could be properly managed without affecting negatively the situation of people depending on the lakes for their livelihoods.

Results of the stakeholder Delphi showed a moderate to fair degree of consensus among the panel members in the matter of perceptions about the aquatic biodiversity of the lake, the existing conservation plans to protect the biodiversity, and the change of inflow of tourists over time (Table 3).

Analyzing all the issues and all stakeholders together, there is a moderate degree of consensus. There is an unusually strong consensus on the dependence of the livelihoods of people on biodiversity. But there is a very weak consensus concerning the change in the local environment over time, the adverse effects of interactions of the people with the lake biodiversity, and the appropriate ways to manage biodiversity without negatively affecting of the livelihoods of the people depending on the lake system.

The role of the stakeholder Delphi methodology in facilitating the establishment of consensus among stakeholder groups showed no effect in this case, as responses in round 2 and round 3 were almost identical for all stakeholders. This is striking, as some of the panel members were replaced from round 2 to round 3, and the outcome may have been

influenced by this. Respondents may have been influenced by the manner in which the questions were framed, communication skills of the local research team members, the way responses were collected, and the time spent on assisting respondents in understanding the questions and in formulating their opinion. In situations of doubt or time pressure, it may be easier for a respondent to merely just agree with what had been said by the respondents in previous rounds. The detailed study can be found in Kundu et al. (2013).

3.4. Vietnam

At the two Vietnam sites, field work on stakeholder evaluations was done in 2011. The stakeholder Delphi was used by the team as a tool for identifying the most important problems, pressures (causes) and solutions (remedial measures) and prioritizing them by using the mean rank.[3] The selection of panel members from local and provincial government offices was made through the respective Heads of Department. The selection of panel members among local community groups was done according to the team's own knowledge of local people in the villages.

[Table 3]

The initial open questions for round 1 were elaborated according to a combination of the DPSIR and the STEPS models. The respondents were asked to list (1) potential problems, constraints or threats facing highland aquatic resources, (2) factors (pressures/drivers) relevant to aquatic resources in the area, (3) suggestions for implementation, activities, policy or institutional measures to better manage and sustainably use aquatic resources.

The standard analysis of Kendall's W and Friedman's X was made for the results of rounds 2 and 3 at each site with regards the degree of concordance of responses concerning ''problems'', ''factors'' (drivers/pressures), and ''suggestions'' (responses), respectively. At this level of analysis, the DPSIR methodology was used as the structuring principle. In

[3] At the other sites, panel members were given the median scores and the distribution of responses in quartiles. This minor difference does not have any importance for the statistical tests on consensus, and was modified for the third round.

addition, an analysis of concordance was made of responses at the sub-level of dimensions inspired by the STEPS framework, distinguishing between physical, environmental, managerial, social, economic, and livelihoods related aspects.

3.4.1. Son La, Vietnam

Letters to 44 prospective panel members for the stakeholder Delphi were sent out, covering local and provincial authorities and various local stakeholder groups, men and women; a total of 39 panel members remained in round 2 and round 3. The stakeholder Delphi was used to explore problems or threats to maintaining ecosystem services; the reasons behind these problems, and the solutions to address them. Detailed accounts for the responses are given in Nguyen et al. (2013). The statistical test of concordance showed weak or very weak levels of agreement in round 2 moving to moderate-strong levels of agreement in round 3 for each of the 3 categories of problems, factors, and solutions (Table 4).

Broken down into ‘‘SMART-inspired’’ dimensions (environmental/physical, managerial, institutional, economic, social and livelihoods-related) the picture in round 3 becomes more nuanced. Thus, for example, there was unusually strong agreement on institutional and economic problems identified, whereas agreement was weak/moderate on managerial problems. It is notable that there was strong agreement on the suggestions for institutional and management related actions and the suggestions for economic development, whereas there was only weak-moderate agreement on the suggestions for ‘‘more regulation’’.

3.4.2. Quang Tri, Vietnam

In Quang Tri, the team sent out 33 letters for selected panel members with the same open ended questions as the letters sent out in Son La; 30 members responded in round 1, 27 in round 2 and 21 in round 3 (Table 5).

At the Quang Tri site, the statistical tests of concordance showed the same pattern of moving from weak or very weak agreement in round 2 towards strong or unusually strong agreement in round 3 (Table 5). Broken down into specific subcategories, stakeholder panel members agreed strongly on the way to assess problems and threats to aquatic resources in Quang Tri, although the environmental threats seem to present an issue where opinions

remained divided in round 3. Details about the responses can be found in Nguyen et al. (2013).

[Table 4]

[Table 5]

Concerning the factors of relevance to aquatic resources in the Quang Tri site, there was very strong statistical concordance of panel members expressing (only) moderate agreement with the proposed factors suggested as drivers and pressures. This points to the need to work more with local stakeholders in understanding the dynamics of the local ecosystems and aquatic resources conservation. The panel members agreed strongly or unusually strongly within each proposed area of intervention. It is interesting to note that although a high level of consensus was achieved on institutional responses (Section 3) at an overall level, consensus on specific regulatory measures remained very weak (see Nguyen et al., 2013).

4. Discussion & conclusions

The main rationale for applying a stakeholder Delphi approach in the cases presented here from the HighARCS project was the need to support the creation of a common picture of the management situation, constraints and opportunities for the aquatic resources in the five local sites among authorities and stakeholders. Considerable differences of opinion among stakeholders were expected. It was assumed that the stakeholder Delphi approach would facilitate concerted action for more sustainable management practices. The outcomes in terms of contributing to increasing the level of concordance among the panel members varied considerably from site to site. But except for Buxa, there was some degree of increase in concordance recorded. This result, however, should be interpreted with caution, as the methodological principle of keeping the same panel members between rounds or else excluding the responses from the statistical tests was not practically feasible for all stakeholder groups. The methodology assumes that the same individuals constitute the panel conducting the self-assessment of scores given in earlier rounds. In the HighARCS data

reported here, the same stakeholder groups have been maintained, but individual members may have responded only in one round.

The stakeholder Delphi was used in an action planning context, in combination with a range of other methods. Several issues should be mentioned in this respect. First, the research and facilitating teams conducting the stakeholder Delphi had developed a quite advanced and comprehensive understanding of the resource management situation at the studied sites in advance compared to what would otherwise be the case in a stakeholder Delphi. It cannot be excluded that this has influenced the way questions have been formulated or responses have been interpreted by teams.

Secondly, it could be argued that the assumed impact of the Delphi technique exposing panel members to the views of others whose views they were not familiar with before may have been partially reduced because of the many occasions of studying these issues offered by the project during the preceding research activities. The open role of round 1 in the typical (stakeholder) Delphi for new and emerging responses was therefore possibly reduced, and panel member positions may have begun to become more entrenched. The main contribution of the stakeholder Delphi to the action planning process then became to document and create a common picture of stances and positions held on the various management issues, as a step in the action planning process.

Thirdly, the communicative role of supporting stakeholder interaction and the creation of a common view of the situation, whether consensus was in evidence or not, was particularly useful in the sites where the stakeholder Delphi was used in combination with the DPSIR (Drivers, Pressures, State, Impacts, Responses) framework which offered a simple cause-and-effect structure for the joint analysis of the management situation at hand (Bunting, 2012; IUCN, 2012; Lund, 2012; Schroll, 2010).

A quality which is usually assumed for the stakeholder Delphi is the ability to include knowledge and viewpoints from otherwise marginalised social groups. In all five cases, such groups had been identified during previous research and were explicitly contacted and invited to be panel members. Some panel members were comfortable in discussion forums

such as stakeholder meetings. But it was not as easy for certain farmers or fishers to be present or even to speak up in such meetings. The stakeholder Delphi therefore seemed appropriate. Where the panel members belong to the authorities or stronger positioned stakeholder groups they could potentially reply to written questionnaires sent by mail. However, special forms of communication such as personalized interviews were found necessary to allow weaker groups to contribute to the stakeholder Delphi process. This approach helped facilitate the joint assessment among stakeholders to better understand the overall situation of competing claims and needs for the wetland resources and their ecosystem services. As a result, inputs and ideas were provided for the identification of issues to be addressed and solutions to be proposed within action plans. The reported outcomes of each round had the advantage of being easy to communicate to wider audiences concerned by the action planning process, thereby contributing to the transparency of the justifications for the choice, objectives and expected outcomes of the selected actions.

The issue of the selection of the panel members should be given special attention. When looking at who was actually invited to participate as panel members, there was a heavy representation of the various authorities concerned by the issues. It cannot be ignored that panel members from other stakeholder groups may have been more influenced by the views and opinions of the authorities due to their high numbers and the methodological approach taken in most cases of pursuing consensus towards the median response. Responses from panel members belonging to low power-status stakeholder groups were observed in one of the cases (Buxa) to have moved from moderate to weak consensus from round 2 to round 3 because of a presumed fear of expressing their true opinions in the beginning of the process. This illustrates important methodological issues of finding appropriate ways to avoid asymmetrical power relations among the panel-member groups influencing the responses in spite of having followed the principle of concealing the responses of the individual panel members in the reported results. To conduct a reliable stakeholder Delphi for participatory environmental planning, skills of facilitation, communication and multi-disciplinary subject matter competencies are required. If precautions are not taken, the outcomes of the stakeholder Delphi technique lose trustworthiness. This in turn may reduce the relevance, efficiency and sustainability of the

resulting conservation and improved livelihood action plans, or lead to undesirable outcomes. Consequently, this concern should be reflected in the composition and competencies of the local teams conducting the stakeholder Delphi tests at the sites. It is suggested that this aspect should be included as a standard element in the methodology section of future stakeholder Delphi reports.

The scores from the stakeholder Delphi surveys were used by the teams to inform the selection of suggested actions with the highest priority. Inviting all stakeholder views to be expressed in the process may create false expectations with regards to the possible action plans which realistically can be implemented. It is therefore important that the stakeholder Delphi method be used in combination with additional tools assessing the feasibility of the proposed actions. This was done subsequently in all five cases reported in this paper (Bunting et al., 2013).

The choice of the two non-parametric statistical tests to assess the concordance of the scores given by the panel members seems justified to the extent that assessing the degree of consensus reached was achieved. This allowed both good comparisons of changes between rounds for a given site and for comparing concordance among sites. However, for further, more detailed analyzes of the differences between stakeholder groups or other demographic characteristics, other statistical tests might be better suited options, such as the ANOVA test applied by the Chinese team. Such analyzes are useful to identify and systematically document where the important differences occur, on which issues or between which stakeholder groups, in view of informing strategies of facilitation, mediation or policies. It is however not always realistic to design the study in accordance with the requirements to conduct ANOVA analyzes on the data, as these statistical tests assume a normal distribution of the responses.

In conclusion, the experience of the HighARCS project presented in this article illustrates the relevance of using the stakeholder Delphi as a method which allows for systematic recognition and documentation of stakeholder positions and knowledge on relevant aspects of a natural resources management planning situation. It also provides systematic opportunities for pursuing joint interaction with all concerned stakeholders in an iterative

fashion, compatible with a joint learning approach to action planning. This quality can be useful to supplement other tools for analysis and support to decision-making used in an action planning process.

When opting to apply the stakeholder Delphi technique, however, a number of methodological caveats should be considered: the selection of members of the stakeholder panel; the way initial open questions are generated; the way to adapt communication techniques to the specific needs and the asymmetrical power relations of the panel members; and how to address the issue of panel members not necessarily being the same individual, but only a person representing the same social or functional group from round to round.

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Table 1 Friedman's X^2_r and Kendall's W at significance levels (*p*) shown for questions indicated for rounds 1–3 in China.

Questions	Respondents	Friedman's (X^2_r)	Kendall's (W)	df	*p* value
Round 1					
Q1-14 Environmental protection	97	174.7	0.166	13	.000
Q17-28 Livelihoods	97	66.6	0.064	13	.000
All questions	97	230.7	0.115	26	.000
Round 2					
Q1-14 Environmental protection	71	182.9	0.238	13	.000
Q17-28 Livelihoods	72	67.4	0.081	13	.000
All questions	71	296.2	0.192	27	.000
Round 3					
Q1-14 Environmental protection	60	174.7	0.280	13	.000
Q17-28 Livelihoods	60	156.8	0.251	13	.000
All questions	60	353.2	0.273	27	.000

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Table 2 Friedman's X^2_r and Kendall's W at significance levels (*p*) shown for questions indicated for rounds 2 and 3 in Buxa.

Questions	Respondents	Friedman's (X^2_r)	Kendall's (W)	df	*p* value
Round 2					
I – State of local rivers and lakes	14	142.0	0.317	32	.000
II – Potential problem constraints or threats facing highland aquatic resources in Buxa reserve (Drivers, Pressures or Impacts)	14	162.9	0.401	29	.001
III – Other issues related to highland aquatic resources (Drivers, Pressures or Impacts)	14	74.6	0.281	19	.000
IV – Responses	14	39	0.398	7	.000
All	14	441.7	0.351	90	.000
Round 3					
I – State of local rivers and lakes	14	53.6	0.120	32	.010
II – Potential problem constraints or threats facing highland aquatic resources in Buxa reserve (Drivers, Pressures or Impacts)	14	35.7	0.088	29	.088
III – Other issues related to Highland aquatic resources (Drivers, Pressures or Impacts)	14	24.2	0.091	19	.187
IV – Responses	14	3.6	0.036	7	.829
All	14	159	0.126	90	.000

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Table 3 Friedman's X^2_r and Kendall's W at significance levels (*p*) shown for questions indicated for rounds 2 and 3 in Nainital.

Questions	Respondents	Friedman's (X^2_r)	Kendall's (W)	df	*p* value
Round 2					
1 – How has the local environment changed over the time? (State)	31	46.4	.249	6	.000
2 – How do the livelihoods of people depend on Biodiversity? (State)	31	61.5	.992	2	.000
3 – Do you think these interactions of the people with Lake Biodiversity have any adverse effect on it? If yes, what are the reasons behind your thinking? (Drivers, Pressures or Impacts)	31	20.9	.135	5	.001
4 – What is your perception about the aquatic Biodiversity of the lake? (State)	31	52.2	.336	5	.000
5 – Is there any conservation plan to protect these Biodiversity? (Response or State)	31	131.7	.425	10	.000
6 – In your opinion, how can biodiversity be properly managed without affecting the livelihood of depended people? (Response)	31	71.6	.256	9	.000
7 – How has the inflow of tourists changed over the time? Mention the reason of the change. (Impact or Pressure)	31	51	.411	4	.000
All	31	514.5	.353	47	.000
Round 3					
1 – How has the local environment changed over the time? (State)	31	46.2	.248	6	.000
2 – How do the livelihoods of people depend on Biodiversity? (State)	31	61.5	.992	2	.000
3 – Do you think these interactions of the people with Lake Biodiversity have any adverse effect on it? If yes, what are the reasons behind your thinking? (Drivers, Pressures or Impacts)	31	19.5	.126	5	.002
4 – What is your perception about the aquatic Biodiversity of the lake? (State)	31	51.4	.332	5	.000
5 – Is there any conservation plan to protect these Biodiversity? (Response or State)	31	131.7	.425	10	.000
6 – In your opinion, how can biodiversity be properly managed without affecting the livelihood of depended people? (Response)	31	71.2	.255	9	.000
7 – How has the inflow of tourists changed over the time? Mention the reason of the change. (Impact or Pressure)	31	51	.411	4	.000
All	31	511.8	.351	47	.000

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Table 4 Friedman's X^2_r and Kendall's W at significance levels (*p*) shown for questions indicated for rounds 2 and 3 in Son La.

Questions	Respondents	Friedman's (X^2_r)	Kendall's (W)	df	*p* value
Round 2					
Section I Potential problems, constraints or threats facing highland aquatic resources (Drivers, Pressures or Impacts)	39	210.5	0.259	28	.000
Section II Factors relevance to aquatic resources in river (Drivers, Pressures or Impacts)	39	28	0.073	12	.000
Section III Suggestions for implementation, activities, policy, institutional to better management and sustainably use aquatic resources (Responses)	39	211.5	0.140	54	.000
All	39	340	0.197	96	.000
Round 3					
Section I Potential problems, constraints or threats facing highland aquatic resources (Drivers, Pressures or Impacts)	39	710	0.650	28	.000
Section II Factors relevance to aquatic resources in river (Drivers, Pressures or Impacts)	39	283.2	0.605	12	.000
Section III Suggestions for implementation, activities, policy, institutional to better management and sustainably use aquatic resources (Responses)	39	1272.9	0.604	54	.000
All	39	2436.1	0.651	96	.000

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Table 5 Friedman's X^2_r and Kendall's W at significance levels (*p*) shown for questions indicated for rounds 2 and 3 in Quang Tri.

Questions	Respondents	Friedman's (X^2_r)	Kendall's (W)	df	*p* value
Round 2					
Section I Potential problems, constraints or threats facing highland aquatic resources (Drivers, Pressures or Impacts)	27	159.1	0.274	29	.000
Section II Factors relevance to aquatic resources in river (Drivers, Pressures or Impacts)	27	108.5	0.212	19	.000
Section III Suggestions for implementation, activities, policy, institutional to better management and sustainably use aquatic resources (Responses)	27	293.6	0.341	43	.000
All	27	677.5	0.405	93	.000
Round 3					
Section I Potential problems, constraints or threats facing highland aquatic resources (Drivers, Pressures or Impacts)	21	485.4	0.797	29	.000
Section II Factors relevance to aquatic resources in river (Drivers, Pressures or Impacts)	21	306.3	0.768	19	.000
Section III Suggestions for implementation, activities, policy, institutional to better management and sustainably use aquatic resources (Responses)	21	722.3	0.800	43	.000
All	21	1606	0.822	93	.000

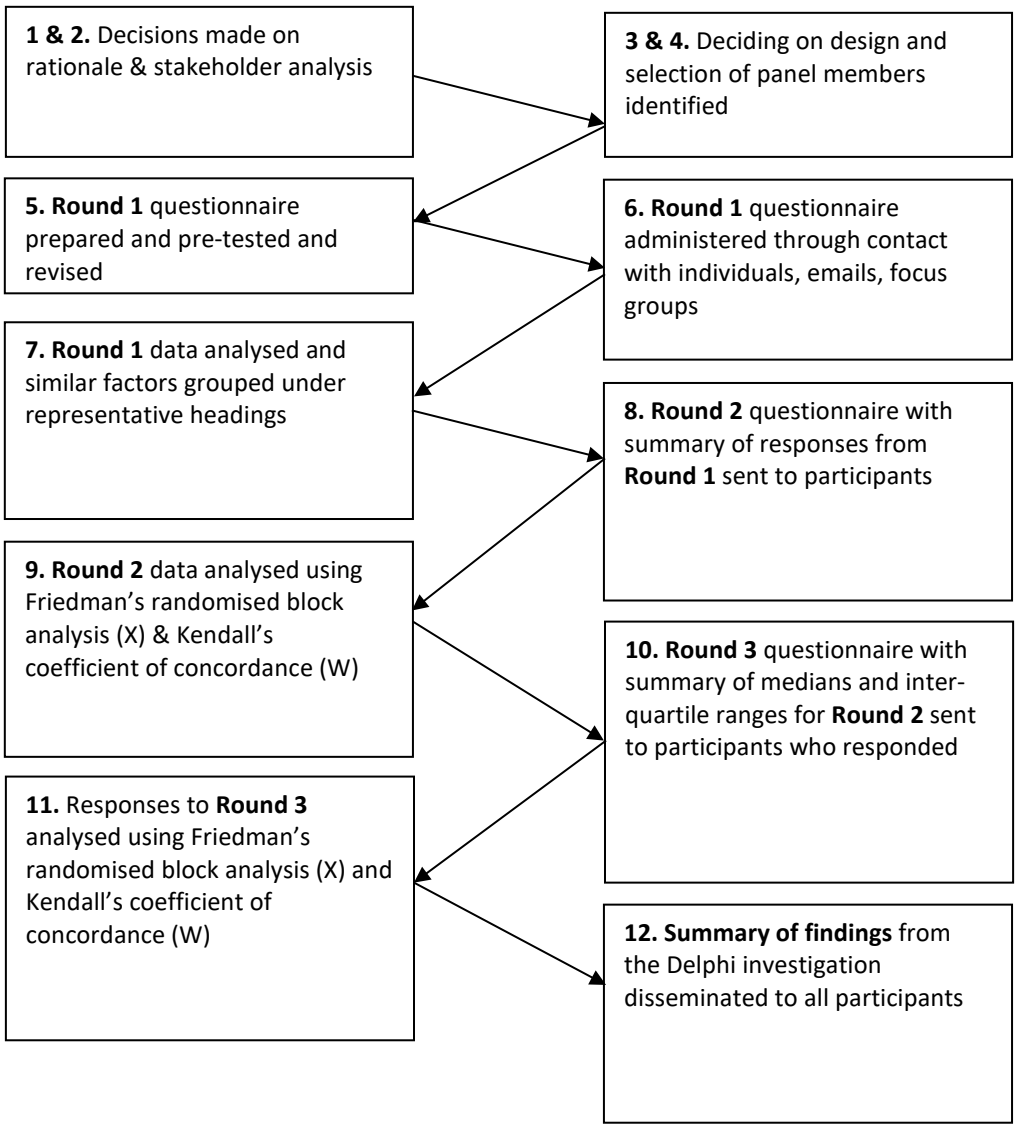

Figure 1. Flow-chart of steps for a systematic stakeholder Delphi process