



## Triangulation in participation: Dynamic approaches for science-practice interaction in land-use decision making in rural China



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### ARTICLE INFO

#### Keywords:

Stakeholder participation  
Method triangulation  
Sustainable land use  
Southwest China

### ABSTRACT

Land use decision making requires knowledge integration from a wide range of stakeholders across science and practice. Many participatory methods and instruments aiming at such science-practice interaction have been developed during the last decades. However, there are methodological challenges, and little evidence neither about the methodological applicability and practicability under diverse socio-political conditions nor about their dynamics. The objective of this paper is to offer some insights on the design and implementation of reasonable science-practice interaction. The Chinese-German project SURUMER (Sustainable rubber cultivation in the Mekong region) served as a case study with the aim of developing sustainable land use strategies for rubber cultivation in southwest China. A triangulation of methods tailor-made for every specific stakeholder group allows the gradual deepening and broadening of participation in problem definition, knowledge generation, development of applicable solutions and implementation. The composition of methods should be reflected on and adjusted to the communication demands of specific stakeholder groups during project phases. It is important to invest in trust-building and allow time and space for the adaptation of approaches, especially in communities where participation is not a tradition.

### 1. Introduction

Ecosystem degradation, over-exploitation of natural resources, climate change and human conflicts are challenging sustainable development worldwide (Brandt et al., 2013). Demand is increasing for approaches that are both “scientifically robust” and “socially relevant” (Romero-Lankao et al., 2013), involving different scientific disciplines as well as practitioners and societal groups in problem-solving and knowledge generation (Harris and Lyon, 2013). Such approaches are particularly crucial in the field of land-use planning, where solutions to complex land-use problems often involve multiple disciplines, scales and actors. By integrating different local and scientific knowledge sources, it may be possible to develop a more rigorous understanding of the future (Johnson et al., 2004), and thus increase the possibility of application of the research results into decision making. However, there is often a gap in these approaches. Researchers value scientific rigidity and precision of academic research and are often less concerned about the practice and application, while practitioners are interested in addressing the existing practical needs rather than theoretical reasoning (Belli, 2010). This might lead to situations in which scientists are frustrated when their information is not used, and practitioners claim that

they did not receive the information they need (Vogel et al., 2007). The challenge hereby is to facilitate interaction among various stakeholders, to build reliable institutions and to reconcile local interests across distinct scales (Stringer and Reed, 2007).

It is claimed that stakeholder participation could cope with these challenges and enhance the quality of research projects (Luyet et al., 2012). Scientific information is likely to have a high chance of application when it is perceived by relevant practitioners to be credible, salient and legitimate (Cash et al., 2003). In addition, it often creates ownership or “buy-in” to the process and thus to the outcomes of the project or policy (Yee, 2010). Many studies show that intensive stakeholder participation results in higher-quality decisions (Beierle, 2002). Over the last decades, various participatory methods and instruments have been developed, resulting in successful experiences such as in Europe (e.g. Dougill et al., 2006; Reed et al., 2013) and Latin America (e.g. Brandão, 2005). However, there are some critiques. For instance, Luyet et al. (2012) argue that, in practice, it is still an expert-driven paradigm with project leaders often defining the degree of stakeholder involvement. Although many projects claimed to adopt participatory approaches, practitioners’ views were not taken into account during the planning process, project implementation or even the evaluation. Non-

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academic stakeholders may be asked about their opinions using questionnaires with pre-defined answers instead of helping to develop their own solutions. Such behaviour may lead to disillusionment (Tippett et al., 2007). The choice of participation methods and the quality of their application become highly important.

Therefore, the objective of this paper is to offer some insights on how to design and implement reasonable science-practice interaction. We designed a triangulated participatory approach for science-practice interaction in the Sino-German research project SURUMER (Sustainable rubber cultivation in the Mekong region) SURMUR (2011), with tailor-made methods for each stakeholder group during the five-year project phase. By discussing the application process and reflecting the effects of our approach to stakeholder participation from an ex-post view, we hope to contribute to the current methodological discussion, considering the Chinese context where participation is not a tradition. Particular emphasis is placed on the question of ownership, i.e., whether stakeholders are empowered, their ideas are taken into account and developed solutions are implemented.

The research question is how science-practice interaction may be facilitated for better land-use decision making, with a specific focus on good practice in method triangulation and under difficult socio-political conditions. The hierarchical institutional arrangements in China strongly support centralised top-down decision making and leave limited space for participation, thus adding further challenges to the applicability and practicability of such methods.

In the following sections of this paper, after an initial definition of participation in a transdisciplinary project environment, we present our triangulation approach on participation, reflect its effects, strengths, challenges and ways to master them, and finally, provide suggestions for future application.

## 2. Participation and participatory methods

### 2.1. Stakeholder participation in research projects

Stakeholders are individuals, groups or organisations that can affect or are (positively or negatively) affected by a decision or action (Freeman, 1984; Grimble et al., 1995; Bryson et al., 2011). For an organisation, such as a research consortium, stakeholders include both scientific stakeholders from the research project and non-academic stakeholders. Persons at the local level are usually those most affected by the issue at stake and are often the greatest experts on many aspects of their situation (Patel et al., 2007). For a general understanding of stakeholder participation, we follow Reed (2008: 2418) who defines participation as "... a process where individuals, groups and organisations choose to take an active role in making decisions that affect them". Stakeholder participation is now inevitable in many research projects to generate better solutions and create ownership of the outcomes of the project. In our case, this specifically refers to situations in which stakeholders actively participate in decision making within the framework of a research project, in defining problems and objectives, generating knowledge and information and promoting solutions with possibly higher acceptance amongst those who implement land use changes.

To understand the theories and principles behind different participation approaches and which methods are most appropriate for stakeholder participation in a given context, we must first look at the different typologies. Stakeholder participation can be classified into four categories according to its theoretical basis, its nature, its objectives and the degree of participation (Reed, 2008). The theoretical basis of participation simply defines whether it is a means of justice and democratic decision making processes or whether it is a tool to achieve a higher-quality decision (Renn et al., 1995; Webler, 1999; Beierle, 2002). Participation demands a two-way information flow between participants and exercise organisers. Information is exchanged through dialogues or negotiations (Rowe and Frewer, 2000). In contrast, one-

way information flow is information dissemination or gathering. Research-driven participation is prone to producing scientific results. In such cases, participation is mainly a way of collecting information for the researchers. This is distinguished from development-driven participation, in which the capacity-building and self-organisation of participants seem to be at the core (Okali et al., 1994). Several levels of participation are usually identified, ranging from passive to active forms. In her influential work, Arnstein (1969) used the metaphor of a ladder to categorise participation in seven levels from non-participation to tokenism, and to true participation at the highest level. Later, Pretty (1995) developed a typology for agriculture development projects that includes seven levels, ranging from passive and manipulative participation to active initiation independent from external bodies.

Depending on the objectives and the degree of participation, there are many methods and techniques available. Warburton (1997) lists more than 100 participation techniques in his review of participation. Single methods might be efficient for one target group at a specific time point with a certain objective for participation. While a project often lasts several years with various groups involved in the ongoing project phases, the participation patterns are often different and mutative, considering the objectives, contexts and conditions. In the context of a project, the question here is: which methods should be chosen for a specific participation process? This depends on various factors, including the degree of participation (Rowe and Frewer, 2000; Yee, 2010; Luyet et al., 2012), stakeholder categories (Beierle, 2002; Reed, 2008; Yee, 2010), local conditions (Luyet et al., 2012) and available resources (Rowe and Frewer, 2000). Thus, triangulation of methods is necessary to meet the multiple demands in projects that involve a variety of stakeholders during different phases. Triangulation, the "... attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint" (Cohen et al., 2000: 254) is seen rather broadly. According to Denzin (1978), triangulation of sources, methods, researchers, theories, data types (text, numbers) exist and increase "...the concurrent validity of findings and decisions through the convergence of different perspectives" (Yeasmin and Rahman, 2012). Nowadays method triangulation (or mixed methods) is common in many fields of research with a rich body of literature, particularly in participatory rural appraisals (Mayoux and Chambers, 2005) or for example when combining qualitative information with quantitative modelling in participatory scenario development (Kok et al., 2015). Usually, these approaches are quite static. We enrich the discussion with a process-oriented focus, assuming that in a transdisciplinary setting the choice of methods must be flexible and reflect the need of a specific situation and actors involved. Such meta-research on the dynamics of triangulation is rare if non-existent.

### 2.2. Stakeholder participation under Chinese conditions

In China, the introduction of methods, such as PRA (Participatory Rural Appraisal) and RRA (Rapid Rural Appraisal), dates back to the 1950s and 1960s (Li, 2003). In the beginning, participatory approaches were mostly limited to NGOs (non-governmental organisations) and academic groups; little had been done directly with the government (ITAD and PRCDDP, 2005). In recent decades, participatory approaches have been attempted in a growing number of projects, such as poverty alleviation projects (Han, 2002). Nationwide there were more than 140,000 key villages established under a poverty reduction plan with a simplified participatory approach (Piazza, 2011). Robert Chambers introduced participatory approaches to Yunnan Province in 1993, on an autodidactic basis at first. After several years of internationally supported projects, some locally initiated projects have begun (Wilkes, 2011). With continuous reflection, the understanding of PRA has been deepened from a set of survey tools to a process of supporting development activities. However, there are fundamental differences between the situation in China and the countries where participation theory and approaches were initiated and developed. In China, political decisions

are often made through a top-down hierarchical system. This means that the administration at the local level and people from grassroots must usually accept decisions coming from the higher level. In such institutional contexts, there is little room for participation in decision making in rural China. From past experiences, low cost-effectiveness, gaps between outputs of PRA and the information requirements of existing planning systems, as well as limited human and financial resources, are seen as obstacles to public participation (Wilkes, 2011).

### 3. Triangulation in participation: the SURUMER approach

Xishuangbanna Dai Autonomous Prefecture in Southwest China is part of one of the world's richest biodiversity regions, known as the "Indo-Burma hotspot". Over the last two decades, the introduction and intensification of monoculture rubber plantations have been the main drivers of robust economic growth with a substantial increase in the well-being of smallholder farmers. This development was coupled with a dramatic loss of ecosystem functions and services (Zhang et al., 2007; Zong and Hu, 2008; Yi et al., 2013). The unbalanced development has resulted in a strong desire for a sustainable land-use strategy. The Chinese-German project "SURUMER: Sustainable rubber cultivation in the Mekong region" was funded by the German Federal Ministry of Education and Research (BMBF) under its Sustainable Land Management program (SLM). SURUMER aims to develop sustainable land use strategies for rubber cultivation in southwest China, with the intention of wider application. It consists of nine research subprojects on both ecological (e.g., soil, water, biodiversity) and socio-economic (e.g., contingent valuation, farmers' livelihood) themes. Changes in ecosystem services and functions by rubber cultivation are assessed and quantified, consequences are modelled, trade-offs and synergies are discussed, and finally, scientific concepts should be transferred into practical land use options. The chance of implementation is assumed to be higher if the practitioners validate these strategies.

Thus, an ongoing dialogue was established between scientists and practitioners. From the beginning, the approach foresaw a triangulation of communication instruments and a high level of flexibility in order to match the complex situation and meet the demands of the different stakeholder groups (Aenis and Wang, 2016). Several challenges were anticipated, and some emerged during the project: (1) The hierarchic top-down decision-making system leaves little space for participatory activities. (2) Participation is a new approach in Xishuangbanna, and practitioners are used to be passive and hesitant to participate – the lack of participation experience increases the difficulty in engagement, which is found in other contexts, too, for instance in Portugal (Santos et al., 2006) and in Bangladesh (Salam and Noguchi, 2006). (3) Land use decisions involve various stakeholders with different interests and levels of power, who are sometimes in conflict with each other (Hurni, 2000; Schwilch et al., 2012). (4) Projects, such as SURUMER, which involve foreign researchers, have particular difficulties in approaching stakeholders which require more time and resources. The different cultural patterns between western researchers and Chinese practitioners have added more challenges. Chinese are in the high-context communication pattern where most of the information exists in the person and very little in the transmitted message, and Germans are in the low-context communication pattern where most of the information in the explicit and transmitted part of the message (Hall, 1976). They encounter communication difficulties and even conflicts because they fail to understand each other in their intercultural communication (Liu, 2003).

#### 3.1. Identification of stakeholders

Stakeholder identification is the logical first step, but it proved to take place over a certain period, such as the entire first project phase. Its purpose is to identify those actors relevant to the discourse, i.e., stakeholders with whom direct communication is required and those to

be involved in specific subproject activities. As a result of continuous discussion within the SURUMER consortium and with local informants, the definition of a stakeholder was shaped gradually, and then a consensus was reached. Stakeholders are divided into four main groups: (1) Scientific stakeholders, including both Chinese and German researchers working in different SURUMER subprojects; (2) Village heads and innovative farmers, as representatives of a large number of rubber farmers who are involved in or affected by rubber cultivation, and who can decide how to cultivate their land; (3) Regional decision makers, who influenced land use planning and local policies, including regional administration, cooperating organisations, institutions and large enterprises; (4) Provincial and national actors, including key actors from policy, administration, research and international NGOs, who influence the broader policy framework.

Even though the process of stakeholder identification was initiated and driven by scientific partners in the project, the contributions of local partners and key informants were indispensable. In China, informal relationships (*guanxi* in Chinese) play a significant role in the social network. Their importance sometimes even surpasses the institutional or political framework, especially in relatively closed communities, such as small cities or remote regions. Additionally, such relationships may be hidden, dynamic and complex. In the beginning, there seemed a large number of parties involved in the land-use management and rubber industry, but it was not clear which ones were decisive or relevant to our project. It was difficult to contact local stakeholders on behalf of a foreign project since they were sensitive to some political issues and hesitant to provide access. With support from our local partner, the Nanban River Watershed National Nature Reserve Bureau (NRWNNRB), SURUMER carried out the icebreaking phase, and we were able to contact practitioners via the links provided by the NRWNNRB, even though the process took longer than expected. Thus, stakeholders identified earlier became key partners in identifying other stakeholders, establishing the snowball. We concluded for our approach that a more legitimate and effective strategy was to identify the stakeholders relevant to our case with the assistance of well-acquainted practitioner participants.

#### 3.2. Stakeholder participation throughout project phases

The SURUMER project had planned three main phases over the course of five years, with multidisciplinary situation analysis dominating at the beginning (1st & 2nd year), integration of concepts and strategies in the mid-term (3rd & 4th year) and, finally, implementation activities (5th year). Throughout the project, an ongoing communication process was foreseen which, from an ex-post perspective, also went in three main phases as identified by Lang et al. (2012): a team-building phase with a focus on mutual understanding of the problem (A), a phase with increasingly collaborative research and exchange amongst stakeholders (B) and a final phase of integration with a focus on implementation (C). The overall goal of the participation process was to build an ongoing dialogue and to communicate effectively among stakeholders to develop more sustainable land-use strategies with the intention of implementation, regarding land-use policy, regional land-use strategy and on-site measures, respectively.

Table 1 shows the numbers of stakeholders who directly interacted with other groups. There were more than 30 researchers involved in SURUMER, and approximately half of them directly interacted with non-academic stakeholders during field research, focus group discussion, workshops, meetings, etc. There were approximately five provincial and 20 regional decision makers and 10 village heads constantly involved in the dialogue in terms of workshops, meetings, interviews and informal interactions. Throughout the project phases, there were no significant differences in the numbers of people, but the level of participation was deepened, and the links were strengthened.

Based on the framework of different levels of participation developed by Pretty (1995), Fig. 1 summarises methods applied during the

**Table 1**  
Numbers of stakeholders involved in different project phases.

| Stakeholder groups             | Numbers of stakeholders involved |         |         |
|--------------------------------|----------------------------------|---------|---------|
|                                | Phase A                          | Phase B | Phase C |
| SURUMER scientists             | 9                                | 15      | 19      |
| Farmers and village heads      | 16                               | 68      | 70      |
| Regional decision makers       | 18                               | 22      | 26      |
| Provincial and national actors | 5                                | 3       | 3       |

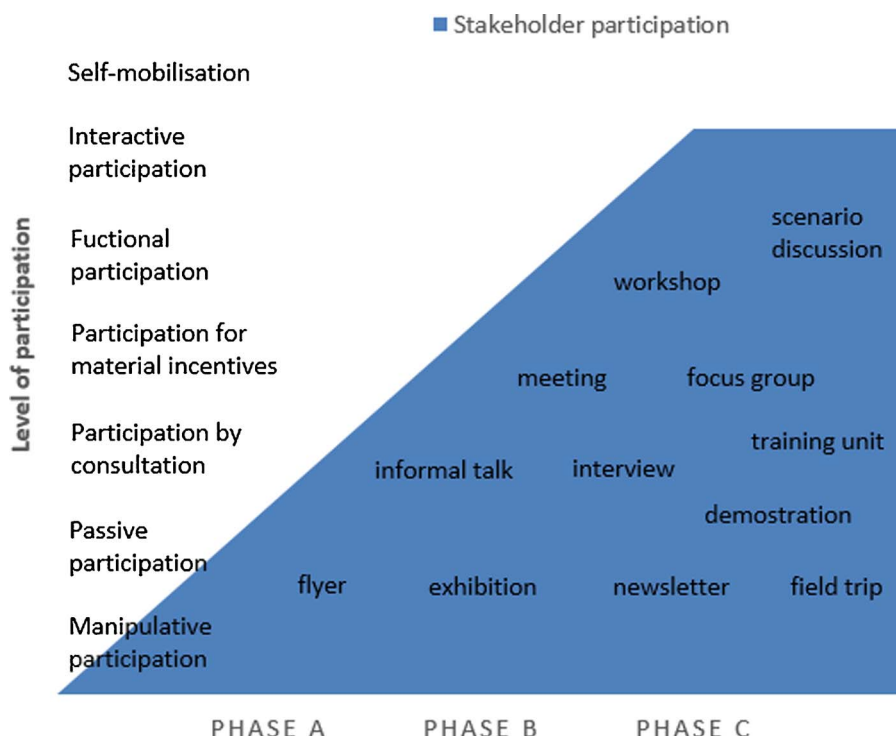
on-going project with gradually intensified participation. Different participation methods were applied depending on the level of participation. Methods for passive participation at the bottom of the figure – flyers, newsletters, a small exhibition with core information on the entire project, as well as field trips were used to introduce the project to the practitioners. Such methods were continuously applied during the whole project as communication channels for exchanging news and information among stakeholders. Moving towards a higher level in the figure, methods for consultation – informal talks and meetings – were sufficient for stakeholder identification providing an overview at the beginning. Open, semi-structured interviews, as well as more in-depth interviews on topics such as “problem perspective” and “interests”, were used as consultation tools to assist in the collection of practitioners’ ideas. A series of workshops provided platforms for scientists and non-academic stakeholders to exchange opinions and make joint decisions. The topic of the workshops were gradually deepened as the project went on, with increasing understanding and trust among stakeholders (see examples in 3.3). Practical and action-oriented learning measures were also implemented, with indoor activities (e.g. focus groups, workshops) supplemented by outdoor activities (e.g. field excursions and on-farm demonstrations). On the other hand, participation techniques were chosen to correspond to the need and communication patterns of each stakeholder group: the exhibition, open interviews and a training unit for farmers; in-depth interviews, field trips, workshops and scenario discussion for regional decision-makers related to rubber cultivation and land-use; and newsletters, meetings and workshops for provincial decision makers higher up in the hierarchy.

### 3.3. Method triangulations and its effects

As mentioned before, the project started with the hypothesis that various target-group-specific methods should be introduced and that these may need to be adapted; thus, feedback was regularly organised (for example, through short “flashlight” evaluations in workshops and meetings). It is a gradual process in which participation is strengthened, and interaction is deepened topic-wise with respect to a specific stakeholder group. Table 2 shows several method-triangulations and the (learning) effects stimulated in different target groups. Some of these issues are highlighted here below:

One main effect is team-building amongst the SURUMER researchers and their direct practice partners (Table 2). In the beginning, researchers were much more focused on their own, disciplinary research with the consequences that many of them neither knew much about the overall approach nor about other subprojects, as stated by an external evaluation after one year. One main reason seemed to be that the project was designed mainly by subproject leaders who regularly met, but not the PhD students and newly recruited staff. To improve this situation, we established a plenary meeting where all participants were able to meet. Over the years, this group jointly analysed the problem situation on site, clarified project objectives, discussed interdisciplinary synthesis, and planned implementation activities. Initiated by the plenary workshop, two respective working groups on scenario definition and modelling were built, which supported interdisciplinary integration. Other methods to support team-building were discussions in ad-hoc-groups, for example, to plan and implement training opportunities for farmers. Team-building improved, and at the end of the study, the research group was able to jointly analyse trade-offs, for example between drinking water quality and rubber yield.

At the beginning of the study, relationships between SURUMER researchers and practice partners were mainly personal links between team leaders and directors of local partners (e.g., NRWNNRB), based on informal talks and meetings. As local partners stated that there is “not enough knowledge about projects and partners”, some more formalised means of participation and exchange have been established, such as formal contracts including regularly updated activity plans (Table 2). Of utmost importance was to constantly document important



**Fig. 1.** Levels and methods of stakeholder participation in SURUMER in the different project phases.

**Table 2**  
Methods triangulation and its effects on different groups of stakeholders.

| Target group               | Initial methods   | Observation/feedback  | Method changes   | (Learning) Effects  |
|----------------------------|---|---|--|---|
| Researchers                | 3-day team-building workshop<br>Subproject-internal meetings<br>Annual subproject leader meetings<br>After 1 year: External evaluation            | Irregular attendance at meetings<br>Late employment of staff, delayed on-site activities<br>After one year: Disciplinary working groups consolidated but low knowledge on other sub-projects and overall approach   | Organisational changes: Steering group, plenary workshops and quarterly newsletter introduced<br>Joint activities: Production of small exhibition, problem analysis and planning in plenary group, regular meetings of PhDs in the field   | More interaction within project: regular attendance in meetings<br>Increased awareness of other groups' and overall projects' progress<br>Interdisciplinary and transdisciplinarity strengthened: interdisciplinary working groups; joint planning of activities toward synthesis; increased awareness toward communicating with non-academic stakeholders<br>Local partner wants to transfer the stakeholder approach to other projects  |
| Local partner (NRWNNRB)    | Informal talks between team leaders and directors of local partner<br>Informal meetings   | Personal relationships developed  | Bilingual information on progress and activities   | Local partner wants to transfer the stakeholder approach to other projects  |
| Farmers/Village heads      | Poster exhibition<br>Informal talk  | "Not enough knowledge about project and partners"<br>General positive feedback on the baseline survey (communication patterns, knowledge on the project)<br>Demand for more information "as easy as possible" on alternative production techniques, esp. agro-chemicals and tangible effects of intercropping | Formal contracts, including activity plans (regularly updated)<br>Visualised focus group discussions<br>Second qualitative survey (willingness to accept water protection and intercropping)<br>Two-day training event on agro-chemical use<br>Demonstration plantation<br>Quarterly newsletter introduced   | Farmers know researchers and their topics, positive attitude: Invitations to local celebrations and events<br>Researchers learned to adjust wording to discuss with farmers<br>Agreement on most important issues (water quality, erosion) and solutions (plan for water protection zone)<br>Farmers' needs fulfilled: Training, demonstration, etc.<br>Gradually adaptation to participatory approach: More active and free to express ideas<br>Gradually deepened understanding of problems and objectives<br>Implementation strategy adapted to stakeholders' interests: Proposal on water protection zone elaborated<br>Scenarios and assumptions are evaluated, and implementation measures are validated by non-academic stakeholders |
| Prefecture decision makers | Stakeholder analysis in villages (baseline survey with semi-structured qualitative interviews)<br>Poster exhibition<br>Informal talk<br>Interview | Demand for more information on project and its research results instead of discussion<br>Two workshops per year seen as too intensive<br>Domination of higher hierarchical levels at workshops<br>Scenario discussion perceived as too scientific   | Reduced workshop frequency<br>Information channels varied: Booklets, presentations, newsletters (all in Chinese)<br>Scenario development: Storyline and assumptions developed by researchers → feedback from non-academic stakeholders → revision of scenarios<br>Less direct contact<br>Newsletters, reports<br>Use official five-year-plan as basis for one scenario | Increased interest: Participation at final workshop, positive feedback on approach and importance of SURUMER  |
| Provincial decision makers | Workshop (twice per year)<br>Field visit<br>Scenario discussion<br>Informal talks<br>Interview<br>Workshop  | "The focus of provincial development is neither rubber industry nor the Xishuangbanna region"   |  |   |



information, such as protocols, contracts and newsletters in both English and Chinese, and actively exchange such information. Two surveys, in which approximately 80 farmers have participated, showed positive effects of the relationship between researchers and farmers: SURUMER people were present for some time in the villages and gave visibility to the project (Aenis et al., 2014). Their uncomplicated methods of interacting helped to build personal relationships, create a positive picture and might have increased propensity (east of village heads, etc.) to continue participating.

Looking at the process from an ex-post view, diverse groups of stakeholders learned to listen to each other and to understand each other gradually through repeated interaction. As shown in Table 2, scientists have changed their attitude toward communication with local stakeholders, from an indifferent attitude to more active listening to farmers' problems and perspectives, and they have tried to phrase topics in the wording of local stakeholders, as well as using visualisation techniques and stories to facilitate understanding of scientific terms. Non-academic stakeholders adapted to the participation approach, becoming increasingly open to the interaction. One indicator for this is that a local partner has expressed their desire to apply the collaboration methods (joint planning and shared responsibilities documented in working plans and contracts) to other projects. Even if not planned, the local partner obviously became aware of the potential benefits of deliberate participatory processes. This indicates changing attitudes toward participation and related behaviour in the long term: A more active role as project partner with some decision-making influence is pursued while also facilitating participation of other non-academic stakeholders.

Another effect is mutual understanding of the problem situation and objectives as the basis for further development of implementation strategies. In the beginning, communication was mainly a one-directional information flow rather than active interaction. Either scientists delivered materials to gain practitioners' understanding and acceptance, or practitioners provided information to scientists for them to better understand the situation. With limited interaction with SURUMER, non-academic stakeholders, for example, prefectural decision makers, were sceptical towards SURUMER, and they tended to remain conventional during the first workshop discussion. In one-on-one interviews, which were designed to be complementary to the workshop in order to acquire a comprehensive picture of stakeholders' perspectives, the same person sometimes expressed their opinions differently. This could be explained by group pressure – they should say things that were “politically correct” in an official setting (e.g., a workshop). During anonymous interviews, participants felt free to express their opinions and personal perspective. The triangulation approach helped to obtain a complete picture, cross-check information and reduce biases as much as possible.

The biggest challenge to mutual understanding was that researchers and practitioners looked at the current situation from different angles. For instance, researchers were focusing on ecosystem services (ESS) and modelling of land use changes, while farmers and regional decision makers placed much more emphasis on the practical issues, such as water quality and quantity, soil erosion, agro-chemical use, labour input and the rubber market. They stated that they would like SURUMER researchers to report more on concrete project results, and they expected more applicable information “as easy as possible” on alternative production techniques (e.g., agro-chemicals) and the tangible effects of intercropping. As a result of this feedback, workshops were adjusted with a strong focus on presenting SURUMER's temporary progress and results on the abovementioned topics and discussing stakeholders' feedback, and the problems and possible solutions. After several workshops, a consensus on the most important ESS (water quality, erosion) emerged, and concrete solutions were discussed (e.g., a plan for water protection). This culminated in a discussion on “future pathways to sustainable rubber cultivation” in the final stakeholder workshop, which can be seen as an important strategic step. Obviously,

scientists learned much about the concerns of local people, which gave them a clearer direction for their research. On the other hand, non-academic stakeholders became more aware of the sustainability issues and more knowledgeable about these due to the continuous exchange with scientists.

Finally, progress regarding an implementation strategy can be observed. For example, one of the major problems is the decreasing water quantity and quality, as mentioned above. During the project, a plan for building water protection zones was jointly developed, considering different disciplinary topics, such as soil erosion, water, rubber yield and agro-chemical use. A “willingness to accept” study was carried out to understand how farmers think about its application and under which conditions farmers would accept establishing water protection zones. This included factors such as farmers' concerns on compensation for income loss and the difficulties of management across village boundaries, as well as technical and financial support. “Responsible use of agrochemicals” was identified as an issue concerning many farmers, and consequently, a training unit was co-designed together with local practitioners. The transdisciplinary project had a mediating role here as it made the needs and interests explicit as well as the challenges of implementation of the envisaged solutions. However, some results were not optimal. For example, the scenarios defined by researchers were not all perceived as realistic by practitioners at the end, when rubber prices dropped dramatically, and some emerging challenges could not be taken up anymore, such as missing soil and water protection clauses in land contracts, etc. The results would have been improved if it was possible to extend reflexivity into the scenario and modelling groups and also plan flexibility in the budget. However, wherever science-practice interaction has been reflected and adjusted, improvements can be observed.

#### 4. Discussion

The project chose a reflective triangulation of participatory methods as part of an overall stakeholder involvement approach, which was adapted to specific stakeholder groups and adjusted throughout the project phases. This generated positive effects regarding science-practice interaction. There are normative and pragmatic claims on the benefits of participation (Reed, 2008). From the normative viewpoint, the triangulation of methods increases the likelihood of involvement since different non-academic stakeholder groups are targeted as much as possible with methods appropriate for them. From the pragmatic viewpoint, the triangulation approach ensures efficient communication via various channels, which together produce holistic and valuable knowledge on problems and possible solutions. As stated by Rowe and Frewer (2000), the most appropriate participation methods are likely to be hybrids of more traditional methods.

Methodologically, this can be characterised as “tailor-made” methods which are adapted to certain degrees of participation, stakeholder categories, local conditions and available resources (Rowe and Frewer, 2000; Yee, 2010; Luyet et al., 2012; Beierle, 2002; Reed, 2008). In contrast to Arnstein (1969) and Pretty (1995), we observe participation as a continuum, from low-level engagement in which non-academic stakeholders are passively informed, to mid-range engagement in which they actively take more responsibility in decision making as consultants or collaborators, to higher-level engagement in which they are leading the process and making their own choices. In our experience in the Chinese context, high participation levels are not necessarily perceived as better than levels with lower participation intensity. Concerning different groups of stakeholders, resources and local conditions, different degrees of participation may be suitable. For instance, a workshop series is a suitable structure for in-depth discussions with key regional decision makers on progressively focused topics; larger scale open interviews could broadly capture opinions from farmers, including marginalised people. Because efficiency and speed in producing results are highly valued by the Chinese people, we understood

that local stakeholders would have their own opinions about what they consider optimum participation levels that do not put too much strain on their available time.

Transdisciplinary research requires flexibility in the methodology since such projects do not always go according to plan due to the high levels of complexity (Leavy, 2011). Given the wide choice of tools and the need to respond rapidly to dynamic contexts, there is a strong emphasis on flexibility and adapting to different and changing circumstances (Reed, 2008), which is essential in the project design. The SURUMER approach was designed with a high level of flexibility to match the complex situation and to meet the demands of the different stakeholder groups. For instance, it aimed to develop scenarios in a participatory way; however, it was impossible to discuss the scientific scenarios with local stakeholders, partly due to the insurmountable gulfs between the modellers' academic language and the language of practitioners, and between scientific scenarios and reality from non-academic stakeholders' perspectives. Instead, the team discussed further expectations with stakeholders during interviews and workshops, which could be translated into trade-offs and integrated into modelling (Table 2, fifth row; see also the Storyline-and-Simulation method by Alcamo, 2008). The timely adaptation of participation methods not only fulfils the needs of stakeholders and builds trust but also contributes to keeping the research focused on the priority of the society. During a final stakeholder workshop, the group of prefectural and provincial actors evaluated the overall approach very positively, discussed different land use scenarios and gave valuable feedback on these scenarios and, most importantly, developed a systematic and formalised land-use plan.

Although researchers may have clearly outlined intentions at the outset of a project, the iterative process of engagement means that there needs to be space in the project for adjustments (Bracken et al., 2015), and some authors emphasise the importance of reflection for performing and analysing participation processes (Elzinga, 2008; Ulrich, 2000; Wechsler, 2014). For instance, during meetings with mixed stakeholders (including people from different hierarchical positions), the discussion was often dominated by those with higher positions, and the people who had lower positions seldom talked. From this observation, we learned that it is better to invite workshop participants with similar positions in order to hear all the participants equally. Finding ways to improve such situations requires patience and a deep and reflexive appreciation of how change happens and the roles of researchers and practitioners (Mitchell et al., 2015). As Popa et al. (2015) summarised, transdisciplinary research would benefit from adopting a pragmatic approach to reflexivity, with a collective process through joint experimentation and social learning.

As claimed by Brandt et al., 2013, although there are strong interchanges of knowledge in transdisciplinary processes, few projects give the authority to make decisions to practitioners. In our case, non-academic stakeholders initially felt like they were being "treated like information sources only", and gradually took on greater ownership while taking part in the process. For instance, regional decision makers were assumed to engage in an interactive way in workshops through visualised discussions on problem situation and "possible futures". However, during the workshop evaluation, they expressed their perception that they were mistreated as an information source and asked for more information from researchers, which clearly expressed the need for a more passive form of participation and more information provision from researchers. This was understandable since they usually gain information, materials or support from workshops organised by the government. As a consequence, the information flow from researchers to non-academic stakeholders was increased by showing even preliminary research results on those issues local people were most concerned with, such as water quality and quantity, soil degradation and value chain studies, in the form of presentations, booklets and newsletters. Although these are rather passive participation methods, the action of "asking for passive forms" itself can be interpreted as an active

and self-directed form of participation. Non-academic stakeholders expressed their needs, negotiated with researchers regarding the way they would like to participate and which information they want to receive, and they continued attending the workshops. This shows a shift in power from a researcher-initiated dialogue to a practitioner-led one. This change can be traced back to the way the deployed methods supported increased ownership. This example shows that not only is the applied method decisive. The way communication is addressed, the transparency, the trust and the joint interests are important as well, as reflected by Reed (2008).

There are dynamics related to higher or lower levels of engagement in the participation process, and it is important to find the optimal form instead of the highest. It proved helpful to start with more passive forms of participation at the beginning to get in touch with local stakeholders and to develop more active forms later when trust had been built. Strong local partners can provide great help with access to further local stakeholders. The results would have been better had we initiated the dialogue with non-academic stakeholders before project start. Participatory science-practice interaction is not yet a common approach in China. Participation in the Chinese hierarchical context often means asking stakeholders some questions, but it is never guaranteed whether the answers are considered or integrated. Our approach was unique because our research went a step further with knowledge integration, empowerment processes and timely adjusted participation methods, which were proven to work well through positive feedback from both researchers and non-academic stakeholders.

## 5. Conclusion

Triangulation of tailor-made methods seems to strengthen participation and user-orientation. It supports the involvement of wide stakeholder groups; creation of efficient communication channels and thus a holistic information exchange. And, finally, the production of results such as in our case elaborated land-use options which consider different stakeholders' needs – at least to a certain degree. Reflexivity can help to timely identify what works and what not in order to adjust at an early stage. This suits a complex situation, allowing for flexible adaptation throughout the process and bring the best out of stakeholder interactions under prevalent conditions. The approach might face challenges such as resistance from internal and external groups due to their underestimation of the importance and necessity of participation. Therefore the participation activities should be institutionalised, for example through written plans and contracts, consensus building as a principle, and bilingual event protocols. Flexibility and reflexivity during the process are essential when dealing with large groups of stakeholders and highly uncertain circumstances. The most important factor seems to be active support of flexibility and reflexivity on all levels: funding, process facilitation, qualification of researchers, etc. However, a high level of flexibility can lead to repeated changes in a project, in our case even structural ones (see "Method changes" in Table 2). Such changes might be perceived as fussy by project participants – a challenge for project management.

The focal questions for future study should include: Under which conditions is a certain form of participation (method, level) appropriate and sufficient? How can we achieve a higher level of participation in the early stage when fundamental decisions are made (e.g., on project objectives and expected outputs)? How can we, the academic community, not only utilise participatory methods for transforming agriculture, but transform participatory methods in support of agricultural transformation? After all, there is no magic bullet. Increasing the amount and intensity of face-to-face interaction and creating an institutional context for that is one feasible way to generate deeper understanding of each other's needs (Weichselgartner and Kaspersen, 2010). The selection of methods and techniques should be considered based on the case-specific situation. It is important for project managers to be open, flexible and responsive to changes, constantly adapting the

plan according to stakeholders' needs, local conditions and resources.

## Acknowledgement

This work was supported by the German Federal Ministry of Education and Research [FKZ: 01 LL 0919] under the Sustainable Land Management program.

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