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Bringing transparency into the process: Social Network Analysis as a tool to support the participatory design and implementation process of Payment for Ecosystem Services

Barbara Schröter[1]*, Jennifer Hauck [2,3], Isabel Hackenberg[4], Bettina Matzdorf[1,5]

[1]Leibniz-Centre for Agricultural Landscape Research (ZALF), Eberswalder Str. 84, 15374 Müncheberg, Germany
[2] Helmholtz Centre for Environmental Research GmbH - UFZ , Permoserstraße 15, 04318 Leipzig, Germany
[3] CoKnow Consulting, Mühlweg 3, 04838 Jesewitz, Germany
[4] Permanent address: Reichenberger Straße 61, 10999 Berlin;
[5] Institute of Environmental Planning, Leibniz Universität Hannover, Herrenhäuser Str. 2, 30419 Hannover, Germany

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Abstract

Payments for Ecosystem Services (PES) are criticized, amongst other reasons, for their basis in ideas suited to the neoliberal political economy and for the unequal distribution of power inherent in such models. However, PES can be a natural resource management approach that combines social and environmental objectives so that they not only serve to protect ecosystems such as tropical forests and wetlands but also to improve social conditions and rural development. Particularly for community-based PES, tools are needed to bring transparency to PES institutional settings and actor constellations by revealing power relations, as well as to empower local actors to engage in social learning through participatory processes. Considering both of these aspects will improve the equity aspects of PES and establish a social context conducive to a payment scheme that considers local behaviors and attitudes towards conservation. Close collaboration – in knowledge co-production processes – between social science and practitioners can address these challenges and support the PES design and implementation process.

In this paper, we demonstrate how Net-Map, as a specific tool for Social Network Analysis (SNA), can make actor relations visible for the purpose of group discussion within participation processes. We present how the results of participatory Net-Map Interviews can be used for participatory PES development, implementation and evaluation. In particular, we explain and discuss this for three case studies in Costa Rica.

We conclude that this combination – using empirical data from social sciences for participatory planning – facilitates the creation of a common understanding of the PES-governance models, the creation of ownership, and the consolidation of transparency and trust amongst the participants, as well as reflection on the existing social capital necessary for implementation. The results of the Net-Map tool support the design of inclusive and adaptive processes that shape institutions, choices, design and the implementation of policy instruments such as PES. The additional value of the tool is that it makes these processes transparent by generating knowledge during a participatory process and helps to balance the actors´ interests and values. This method of undertaking research in combination with workshops has its limitations, as it reveals – to a group – confidential information given in personal interviews. Further, for the scenario development of PES design, actors must have a certain level of openness and creativity so that the PES design does not merely end up being a copy of the initially net-mapped PES example.

Keywords: Transdisciplinary research, participatory research, Net-Map tool, environmental planning, governance, community-based conservation, Costa Rica, ecosystem service governance

1. Introduction

In recent years, the idea of Payments for Ecosystem Services (PES), defined as a program in which "land users are paid […] for reducing allowable negative external effects on ecosystem services or for taking action to preserve or restore ecosystem services and biodiversity" (Matzdorf et al., 2014 :12), has been promoted as a progressive governance model for environmental protection (Engel et al., 2008, Wunder, 2008). PES foster the provision of ecosystem services and biodiversity for the benefit of human well-being, which means that this type of natural resource management may not only protect nature but also has positive impacts on social issues, such as poverty alleviation, rural development and the improvement of socio-economic conditions in general (Adhikari and Agrawal, 2013, Pagiola et al., 2005, Muñoz-Piña et al., 2008). Consequently, PES is one approach to combine social and environmental instruments for natural resource management.

Nevertheless, PES are also criticized, mainly for three reasons (Van Hecken et al., 2015): 1) PES instruments are inappropriate because they use market-based solutions to environmental problems caused by market capitalism (Wittman et al., 2015, Anderson and M'Gonigle, 2012, Norgaard, 2010, Muradian et al., 2013, Lohmann, 2008); 2) ES are seen as commodities based on separate, additive entities, which neglects the complex dynamics between ecological and social systems (Kosoy and Corbera, 2010, Muradian et al., 2013); and 3) PES hardly consider aspects of environmental justice (Martin et al., 2014, Sikor and Newell, 2014, Pascual et al., 2014). PES suffer from "incomplete information, particularly regarding the relationship between ecosystems, human interventions and the provision of environmental services." (Muradian et al., 2010). Van Hecken et al. (2015) go a step further, arguing "that current approaches to PES remain weakly theorized, socially and politically, resulting in a merely superficial understanding of the roles of culture, agency, social diversity and power relations in the shaping of PES institutions and their outcomes." To confront these challenges, the authors claim that an "actor-oriented perspective with focus on power, related to knowledge, meaning and inequality, can help de-fetishize and re-politicize PES, and contribute to a better understanding of how purposely designed policy interventions are adapted locally so that they tend to materialize in unexpected ways." (Van Hecken et al., 2015: 118) Therefore, stakeholder participation during the process of PES design and implementation is essential to the development of locally adapted PES and equitable approaches to PES.

Social Network Analysis (SNA) is a suitable methodology to uncover involved actors, their motivations and power relations, and institutional settings. Thus, SNA can be used to bring transparency into PES governance and to foster social learning and co-production of network knowledge. These aspects have been proven to support the closure of similar gaps in other areas of environmental governance (Hauck et al., 2015).

We follow Reed et al. (2010) and understand social learning as a "change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks" (Reed et al., 2010). This highlights the importance of social interaction, such as social networks, for social learning: networks influence people´s opinions and views through the transmission of information and deliberation of ideas (Hunter et al., 1991, Winter et al., 2007). Therefore, learning is situated within wider social units or communities of practice (Wenger, 2000), defined as "groups of people informally bound together by shared expertise and passion for a joint enterprise" (Wenger and Snyder, 2000: 139) . Social learning is a process of social change in which people learn from each other in ways that can benefit wider social-ecological systems. However, it cannot be automatically assumed that the conditions and methods necessary to facilitate social learning are available.

Both concepts, SNA and social learning, can be brought together under the framework of knowledge co-production (Schuttenberg and Guth, 2015): facilitated collaboration, which emanates from individual capabilities, is needed within a co-production process. This process produces three types of outcomes: immediate outcomes (such as neutral working space, empowered stakeholders, strong social capital in terms of relations and cooperation between actors, transformative learning); intermediate outcomes (such as the genuine constituencies and influential knowledge that the

stakeholders perceive); and ultimate outcomes (actions that are implemented and reflect the best available knowledge).
Knowledge co-production refers to "an inclusive, iterative approach to creating new information; it is distinguished by its focus on facilitating interactions between stakeholders to develop an integrated or transformational understanding of a sustainability problem" (Schuttenberg and Guth, 2015). Therefore, knowledge co-production can be both a governance strategy and a research method. (Schuttenberg and Guth, 2015). Here, we understand knowledge co-production as scientific integration – as exchange and collaboration among scientists and local stakeholders (Mauser et al., 2013, Lang et al., 2012). There is a knowledge gap with regard to the methods and concepts used in knowledge co-production: "Co-production of knowledge in global change research changes the way research is done and needs new methods and concepts. It requires appropriate communication tools, institutional arrangements, and tailored funding possibilities." (Mauser et al., 2013 :428).
In this paper, we approach co-production as both a governance strategy and as a research method. Our research question targeting governance aspects is as follows: How can we use SNA for participatory planning procedures to develop and implement locally adapted PES? Our question targeting the research method is as follows: Is SNA a tool for knowledge co-production and social learning in the context of developing locally adapted PES?
This article is structured as follows: In chapter 2, we present our three case studies and the initial situation surrounding participatory processes. In chapter 3, we introduce the methodology used in this paper. In chapter 4, we present our results regarding the two research questions; that is, the suitability of SNA for participatory planning procedures as well as for social learning. Finally, in chapter 5, we discuss our results and critically reflect on the additional value of using a social-empirical method for participatory PES development and implementation; we end the article with concluding remarks.

2. Three case study settings

This study was part of a larger transdisciplinary research project on the capacity of civil society organizations (CSOs) and their networks in community based environmental management. As the project followed a transdisciplinary approach, it aimed to foster knowledge exchange between researchers and local stakeholders; additionally, a transfer of best practices in environmental management was anticipated within the different regions. In Costa Rica, the best practice in environmental management was a community-based blue carbon PES project in Golfo Dulce. Transfer regions were Térraba Sierpe and Nicoya, where PES had been planned but not yet implemented, or not yet planned but in the early phase of development. In this way, the research project tested the improvements to and development of an existing instrument – such as PES – in new contexts. Additionally, the CSO´s rootedness was different in the three regions: in Golfo Dulce, the CSO had a long history of local engagement, but the CSO was less rooted and was newer in the other two regions.

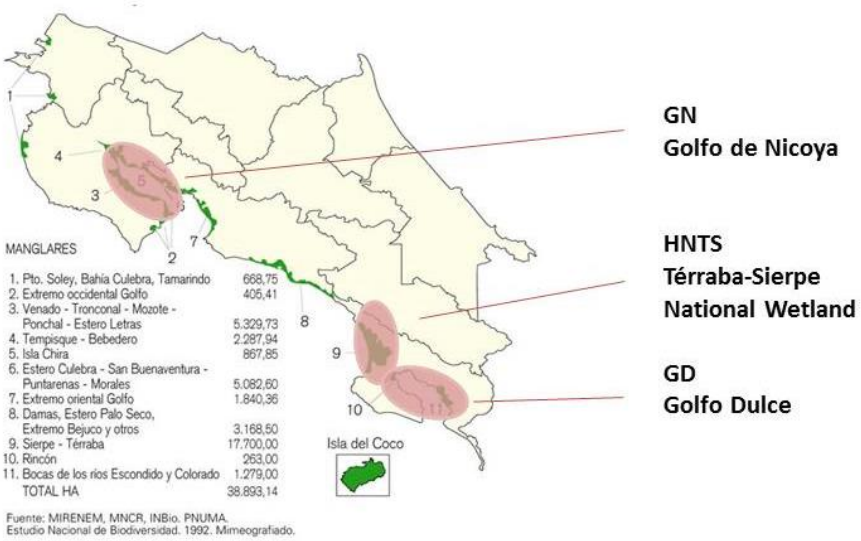

Figure 1: Map of the case study regions in Costa Rica.

Source: Adapted map “Cobertura de Manglares” (Mangrove cover) from MIRENEM, MNCR, InBio, PNUMA. Estudio de Biodiversidad. 1992. Mimeography.
http://www2.inbio.ac.cr/es/biod/estrategia/Imagenes/

- *Golfo Dulce*

The Golfo Dulce region on the Osa peninsula is situated on the Southern Pacific Coast of Costa Rica; it is located in the Puntarenas province and is part of the Osa Conservation Area (ACOSA). The project investigated here is located on the inner side of the Osa Peninsula, on the shores of the Golfo Dulce Bay. The entire area is one of Costa Rica´s best preserved wilderness areas and is a biodiversity hotspot thanks to its rich mangroves and other wetland ecosystems. Mangroves provide valuable ecosystem services such as carbon storage, biodiversity, prevention of soil erosion and recreation. Mangroves capture large amounts of CO_2, both from the plants that compose them and from those plants' deposits. They store up to five times more carbon than tropical forests, and therefore they are of great significance in the fight against climate change (González Vega and Herrera Montero, 2010).
To foster conservation of these important coastal ecosystems, a CSO, together with the local communities and national companies of different sectors like car and beauty retailors, established the so-called Community Blue Carbon Project (). The project shows all characteristics of a payment for ecosystem services (PES) system. The CBCP program works as follows: companies buy a type of restoration package for a certain amount of money, and the package is backed by a formal contract with a CSO. The package includes the establishment and operation of a plant nursery that grows seedlings of four different mangrove species; the seedlings are later distributed and planted in different areas of the Golfo Dulce. The package also includes the reforestation of the seedlings, monitoring of the process and educational activities with local schools. The CSO then makes a separate contract with the local fishermen's association, and the fishermen are free to organize themselves in order to fulfill the tasks agreed upon in the contract. The CSO provides help and support where needed, and it monitors the fishermen's activities.
In order to obtain the agreed-upon remuneration, the fishermen's association is required to submit periodical written reports about the work done in the nurseries and forests. After fulfillment of the contract, the money is transferrCBCPed directly to the association's bank account and distributed among its members. The companies, for their part, try to redistribute the costs to their clients. For

example, in the case of a car retailer, the company attempted to sell climate certificates for every car sold in order to make that sale carbon neutral.
The functioning of the PES model is facilitated by the permanent local presence of the CSO in the Osa Region through a local field station. This results in permanent exchange between the CSO and locals, and it results in the existence of a community of practice and stable social capital for common activities.

- *Térraba Sierpe*

Térraba Sierpe is a protected area called National Wetlands (Humedal Nacional de Térraba-Sierpe - HNTS) and contains the largest area of mangrove cover in Costa Rica. As a RAMSAR site according to the Convention on Wetlands of International Importance and Waterfowl Habitat, it has special importance. Humans are allowed to live within the area and use its resources in a sustainable manner. After a long process of joint work and discussion, a management plan for the area was published at the end of 2013. This plan details which regulations must be followed by future nature conservation projects such as PES. The ecosystem of HNTS, which consists of mangrove wetlands, is similar to the Golfo Dulce region. However, while Golfo Dulce is situated in a bay and is therefore protected, HNTS is exposed to the sea, which implies more salt entry (www.sinac.go.cr).
The local community of the HNTS is committed to a restoration project called Comunidades Azules (Blue Communities), which is designed similarly to the Communitarian Blue Carbon Project (CBCP) except that the donors/buyers are different. The local partner organization is also a fishermen's association. To begin the implementation of the reforestation project, a nursery for mangrove seeds and plants must first be created. Additionally, reforestation and awareness-raising are two goals that the project aims to achieve. Nevertheless, before it can begin, the project still has to wait for the approval of the HNTS management plan. Therefore, in this study, we consider it as a planned PES that currently lacks implementation.
The CSO has already conducted several projects in the region and has supported the development of the HNTS Management Plan. The CSO´s field station in Golfo Dulce is relatively close (a two-hour drive); however, unlike in Osa, it is not as known to the local population. Thus, the CSO has a presence in the region, but because it has no permanent representation, its ties with the locals are a bit weaker.

- *Nicoya*

Nicoya is situated in the Manzanillo District in Puntarenas. The region that comprises the Golfo de Nicoya is located in the central-North Pacific of Costa Rica. It is part of three different conservation areas: Pacifico-Central (ACOPAC), Arenal-Tempisque (ACA-T) and Tempisque. The Golf of Nicoya has the protection status of a Marine Multiple Use Area (Área Marina de Uso Múltiple Golfo de Nicoya – AMUM), while mangroves in the area are still mostly protected by their general status as a natural state patrimony (Patrimonio Natural del Estado). However, this status is not managed by any administration.
The zone has a strong link with the Central Valley, one of the country´s most densely populated regions, that is also the main generator of waste water and solid waste in Costa Rica. This connection mainly exists through the Rio Grande de Tárcoles basin, which is considered one of the most contaminated basins in Central America. Because the mouth of this important river is located in the Pacifico Central and because of the disposition of the marine currents, Golfo de Nicoya has been a depository of waste and contaminated water for years. Consequently, the mangrove areas of the Golfo de Nicoya are few and in a bad shape.
The Corredor Biológico Pájaro Campana (PC), founded in 1992, is a biological corridor that serves to foster the collaboration of actors from different protected areas in the region; these actors are represented in a local council and supported by a strategic plan. The corridor was created to bring together different actors who are engaged in biodiversity protection and to ensure the connection of ecosystems, with consideration of their equitable use by the communities situated within the corridor.

Especially, activities are to support and preserve the habitat of a representative bird species, the three-wattled bellbird (Pájaro Campana in Spanish) (www.cbpc.org).
In Nicoya, the CSO´s activities are in their initial phase. The CSO runs a field station which, in comparison to the field station in Osa, must still be developed. It is smaller than the Osa station, has no permanent staff to attend to local issues, and offers no permanent educational activities. The CSO is engaged in activities related to the biological corridor, which mainly aim to bring together different actors and coordinate activities regarding ecotourism, with the goal of creating synergies. Communities in the area are connected, but so far, there is no PES proposal for mangrove protection.

3. Methodology

To investigate the suitability of SNA for social planning, we used a variety of methods: Net-Map interviews, workshops using SNA and Strenghts-Weaknesses-Opportunities-and-Threats (SWOT) – Analysis, and participatory observation.

3.1 Net-Map interviews

First, we conducted Net-Map interviews to collect and analyze SNA data. Net-Map is a participatory tool for Social Network Analysis (SNA) based on in-depth interviews during which the interviewee draws a map of the important actors and their relations. At the end of the interview, the completed network is visible (Schiffer and Hauck 2010). In addition, data about the actors´ motivations and importance are also collected. In detail, the interview consists of four steps: In a first step, the interviewer identifies the important actors who influence a network she wants to understand. In our case, we asked about the influence of the actors in the Blue Carbon PES in Golfo Dulce and noted their names on actor cards. In a second step, the interviewer asks about different links she wants to understand, and she connects the respective actors on the board by drawing multicolored arrows. We decided to ask for seven different relations: personal contacts, trust, flow of funds, written contracts, exchange of written reports, exchange of knowledge on mangroves, and exchange of knowledge on general environmental issues. During the third step, the interviewee provides more details on the network by defining the motivation of each actor and marks that motivation with a symbol beside each actor´s card. In our interviews, we presented the interviewee with a list of five previously defined motivations: economic, ecological, social, image-related, and knowledge-related. Economic motivation meant that the actor was mainly interested in the financial outcome of the PES, while ecological and social motivation meant that the actor was interested in improving ecological or social conditions with the PES. In cases of image-related motivation, the actor participated in order to improve its reputation as a supporter of socio-ecological aspects, and with knowledge-related motivation, he or she participated to in order improve his/her knowledge of the environment in general and mangroves in particular. In a final step, the interviewer asked how strongly each actor influenced the PES. While answering, the interviewee built towers out of small bricks for each actor according to that actor’s estimated influence. The greater an actor’s influence, the higher the corresponding tower would be. Additionally, we repeated the fourth step, asking not only about actors´ influences but also about the benefits they derived from the PES.

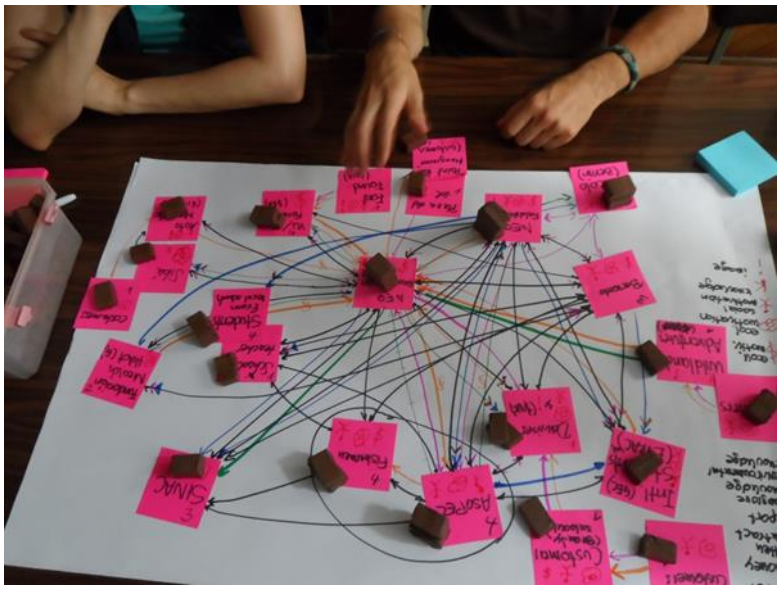

Figure 2: Picture of a completed Net-Map

Source: First author.

In this way, we used the Net-Map tool for data collection to gain knowledge of the existing network for the PES model. We investigated the different stakeholder groups with regard to their influence on and interests in the existing PES; we also tested which actors influence PES implementation with financial resources and knowledge, and we assessed their motivation for participating.

The advantages of this tool are the combination of qualitative and quantitative analyses, as well as the participatory manner. Due to the capture of qualitative data the context of the social network can be explored and SNA measures can be calculated. The network map as a result is visible immediately which allows a direct discussion with the interviewees and supports a common understanding. By drawing the net while interviewing, the interviewees get less bored and learn while they reflect about the network.

Between March 10 and 13, 2014, we conducted eleven Net-Map interviews with a total of 20 participants in the case study region where the PES is fully implemented. We interviewed single persons or groups of up to four participants, mostly in the homes or in the offices of the participants.

According to the methodology, representatives of each actor group were interviewed to get an entire, reliable and validated Net-Map as result. Therefore, we conducted two of the eleven interviews with representatives of the donor companies (six persons, three women, and three men), four with members or former members of the CSO (six persons, two women, and four men), and five with community members from the target region (eight persons, three women, and five men) who were, participants and non-participants in the PES model. We also tried to balance the interviewees´ gender and age.

Interviews lasted between approximately one and two-and-a-half hours and were conducted in Spanish or English, depending on the participants´ language skills. We recorded all interviews under the condition that they would remain confidential, and we transcribed them.

3.2 Workshops

Subsequently, we conducted three workshops (each lasting a full day) where we integrated these SNA results. The workshops where held in three different case studies regarding the design and

implementation of the PES – a fully implemented PES model, a planned but not yet implemented PES model, and awaiting the development of a new PES model (see figure 3). This was thought to analyze and discuss the implemented model with the participants before presenting it to the other case studies and discussing its feasibility for them. In consequence, results from the first workshop in Golfo Dulce (GD), the region, where the PES model has been fully implemented (in the following referred to as GD workshop) were presented in the other two workshops by a team of three GD community members. Representatives from all important actor groups in the PES model were invited with the aim to balance power relations. Participants from the CSO varied according to their responsibility for the respective case study area (for an overview, see Table 1). All workshops were facilitated by three researchers, who, together with the CSO, invited the participants.

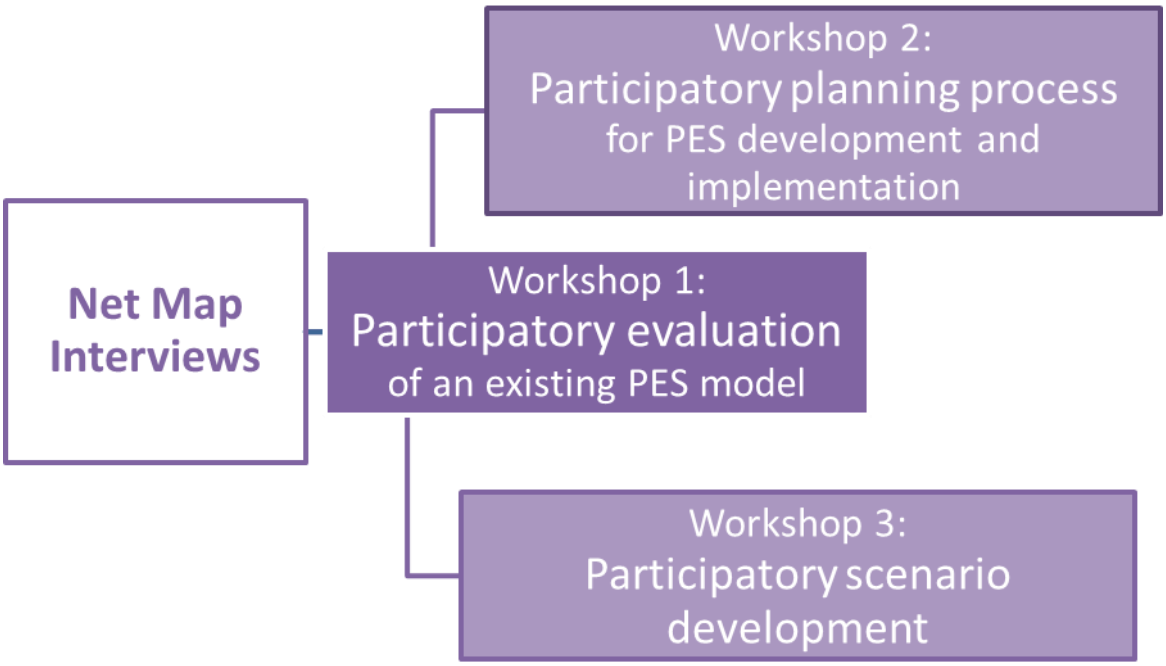

Figure 3: Overview of the use of SNA in participatory evaluation and the PES development process

Source: Own elaboration

For the GD workshop all people who participated in the Net-Map interviews were invited in order to provide feedback and accountability on our research activities. Altogether, 16 people participated, nine from the community, five from the CSO, and two from the donor companies. Participants were expected to develop a common understanding of different actors and their interactions in the PES model – the Communitarian Blue Carbon Project – as well as to identify strengths and weaknesses of the project. Ultimately, they were expected to exchange challenges and suggestions for improvements and ideas for new projects in the tradition of Blue Carbon.

In the Humedal Nacional Térraba Sierpe workshop (HNTS workshop), 13 people participated: two people from the donor companies, four people from the CSO, four people from local communities and three people from GD communities. Representative of the conservation area were invited but the attendant had to leave after a short time due to an emergency. Participants were informed about the Blue Carbon Project in Golfo Dulce, with the goal that they would be able to reflect on their own situation with regard to the Blue Community Program in the Sierpe Region. They also discussed challenges and suggestions for improvements of the current program and ideas for new projects in the tradition of Blue Carbon.

The Golfo de Nicoya workshop (GN workshop) was attended by a total of twelve people, six from the local communities (one of them from the biological corridor PC), two from the CSO and three from the GD communities. Possible local donor companies were invited but did not arrive. As there is no existing PES model in the Nicoya region, the aim of the GN workshop was also to inform participants about the Blue Carbon Project in Golfo Dulce, to reflect on the situation in the Nicoya Region and to discuss challenges and suggestions for possible projects – in the tradition of Blue Carbon and involving tourism – for this region.

During all three workshops we used the Net-Map tool to present the SNA and a SWOT -Analysis to evaluate the PES models. The participants identified current Strengths and Weaknesses, as well as future Opportunities and Threats, of the PES. In a first step, each participant got a yellow card for the strengths and a blue card for the weaknesses and could note down one strength or weakness on each card. The cards were collected, explained by each participant and arranged on the board. In a second step, opportunities (green cards) and threats (red cards) were collected in a brainstorming session with the entire workshop group. The facilitator noted the keywords and arranged them on the board. The results were discussed, with a focus on possible improvements and future scenarios for similar PES projects.

To measure social learning, in each workshop we let the participants reflect on their expectations and learning effects before and after the workshop. Before starting, they noted their expectations on cards, and after finishing the workshop, they noted what they thought they had learned. Based on this information, we conducted a content analysis to classify the participants' comments on the lessons learned.

Table 1: Sequence of activities

Activity	Place	Date	Participants
11 Net-Map interviews	Golfo Dulce	March 10-13, 2014	20 (8 from the local communities, 6 CSO members, 6 from donor companies)
GD Workshop: Participatory evaluation of an existing PES model	Golfo Dulce	March 14, 2014	16 (9 from the local communities, 5 CSO members, 2 from donor companies)
HNTS Workshop: Participatory planning process for PES development and implementation	Húmedal Nacional Térraba-Sierpe	March 15, 2014	13 (3 from GD communities, 4 from the local communities, 4 CSO members, 2 from donor companies)
GN Workshop: Participatory scenario development	Golfo de Nicoya	March 17, 2014	11 (3 from GD communities, 6 from the local communities, 2 CSO members)

Source: Own elaboration.

3.3 Participatory observation

This paper's analysis is more evidence-based than empirical, as it is mainly based on participant observation. Participant observation is a qualitative research method in which the researcher participates as an observer in the daily routine of the persons or groups he is investigating, with the goal of obtaining a better understanding of their perspectives (Lamnek, 1995: 243). It is important to obtain access to the field, to understand the points of view of the observed actors and to identify their patterns of action (Fenno, 1986). In addition to observation, informal conversations and interaction with members of the study population are also important components of this method. Participant observation is not structured, it is very flexible, and it is transparent and not hidden; the object and the perspectives of observation arise during the observation (Berg, 2004, Kawulich, 2005).
Our research team observed the workshops we conducted with the stakeholders but also had a longer field stay of four weeks in the area. We recorded the observations in workshop minutes and field notes, which we used to write this paper.

4. Results

4.1 SNA for participatory planning procedures to develop and implement a locally adapted PES

4.1.1 *GD Workshop: Participatory evaluation of an existing PES model*

The GD workshop´s goal was the participatory evaluation of an existing PES model. We started the GD workshop by presenting a quick first analysis of the network map for the PES, based on information gathered in the individual Net-Map interviews in which most of the workshop participants had previously taken part. In preparation for the workshop, we had aggregated the data by counting actors, links, motivations and tower values of all eleven interviews. For this first analysis, we only included the ten most important actors out of the 26 overall actors who were mentioned, the money flow among these actors, their motivations to engage in the PES and the height of the benefit tower for each actor – showing which actor, according to the interviewees, derived the greatest benefit from the PES. After the presentation of our results during the workshop, every participant was invited to complement the network map with one actor that was important to him and that was not mentioned on the board. The final model – with some actors (municipalities, non-organized fisherman, an international mangrove expert, school, the Ministry of Environment, Energy and Telecommunications) added during the workshop (on the green cards) – is displayed in figure 4.

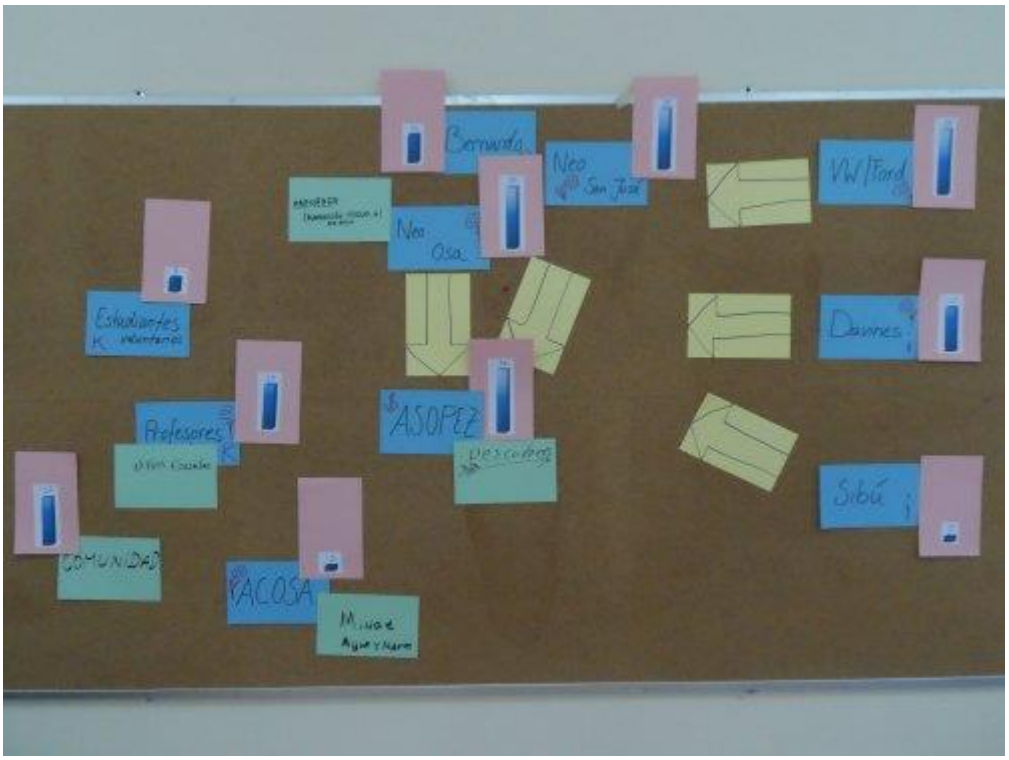

Figure 4: Net-Map based governance model of the Blue Carbon Project in Golfo Dulce presented at the evaluation workshop (Photo: First author)

Legend: Actors identified by interviews
Additional actors
➔ Money flow
benefit tower

This exercise was designed to encourage thinking about new actors that could be useful for the improvement of the PES model, to foster understanding, to provide room for discussion and to help the stakeholders reach a common understanding about the PES model. A discussion followed, focusing on how the participants interpreted the model and whether they agreed with it. In general, the participants agree with the model. Most surprising learning effects were reached by the understanding of the different financing options.

This reflection was necessary in order to generate sufficient knowledge for a discussion of the advantages and disadvantages of the PES in the following SWOT analysis. The exercise served to transform knowledge generated through the Net-Map process into understanding and to apply it to future scenarios. The reflection on the network map revealed underlying power relations and their consequences for future development. The fishermen, for example, had experienced that the CSO also has its own interests, such as performing its job. Additionally, the fishermen observed how much the network depends on donors.

The strengths of the PES model revealed in the SWOT analysis were environmental aspects like the protection of marine species and air purification, the building of social capital, gain for the community, learning effects, training and technical attendance for the fishermen. Opportunities arising from these strengths were seen in the reputation of the fishermen organization, more economic opportunities for the region as more similar projects could be set up, the combination of the PES with tourism and the replication of the model. As weaknesses were mentioned the influence of other ecosystems on the mangroves, like contamination and erosion of rivers, little support from governance institutions,

economic instability due to the program character and the dependency on donor, as well as the lack of environmental education and interest in the region to be able to include more people. These weaknesses could become threats if the social capital and other achievements are lost, the program is interrupted or public policies change.

Next, participants were encouraged to think about new actors who could be included in the established PES or in initiating new types of PES. Ideas about other PES projects in Golfo Dulce concentrated on three questions: What could the local participants do with the knowledge they gained during the project? How could the financing of the project be improved? And how could the local community become more involved? As main ideas for improvement the participants mentioned the creation of new projects seeking for production linkages with activities such as fishing, tourism and mariculture; new financing mechanisms like sale of other ecosystem services based on knowledge acquire, voluntary contributions by tourists or mixed funding sources running simultaneously (individuals, events, corporate, etc.); the use of economic activities that require more community involvement and the expansion of environmental education programs and activities like festivals that attract communities and tourism, regarding conservation issues such as mangroves.

The final activity was intended as preparation for elaborating ideas for new projects that could be developed in the region to improve the protection of mangroves and foster local communities. First, the group was asked to think of the ecosystem services (ES) they obtain from the mangroves (food production of fish and molluscs, water purification, carbon storing, barriers against hurricanes, soil fixation, natural beauty, recreation and tourism, habitat for fishes and molluscs, water birds and mammals). Then, workshop participants made a list of the beneficiaries of the ES, as well as of the threats that could arise for the provision of these ES. Finally, actors in possible PES models were collected: actors who use the mangroves, actors who damage the mangroves and actors who want to do something for society and the mangroves. These categories were not excludable, as the same actor can be in all three categories, e.g. tourist enterprises, but participants became aware of which actors may be included in a further development of the PES or the development of a new PES model.

4.1.2 HNTS Workshop: Participatory planning process for PES development and implementation

The HNTS workshop aimed to support the planning process for the development and implementation of an existing PES. It was held in the Térraba Sierpe region, where a PES model was planned but not yet implemented. In this workshop, local stakeholders of the Blue Carbon Project in Golfo Dulce who participated in the GD workshop (and the Net-Map interviews) presented, in a first step, their PES model, which had been refined and agreed upon during the GD workshop. Once they understood the PES in Golfo Dulce, the next activity for the participants was the joint development of a model for their own PES project, “Blue communities”. People focused on thinking about the actors taking part in the model and compared them to the main actors in Golfo Dulce. The main difference was the donor which in the HNTS case is not a national company but an international institution and the running of the project by two local associations – fishermen and mollusk collectors.
Based on the Net-Map-based PES model in Golfo Dulce and the adapted PES model in Térraba Sierpe, participants then discussed the similarities and differences of both PES projects, as well as the challenges for their own PES in Térraba Sierpe. The discussion was structured by another SWOT analysis based on that used in the GD workshop but modified slightly. Instead of strengths and weaknesses, similarities and differences between the two projects were collected before the opportunities and threats of the local PES were discussed. The participants identified similarities like activities (nursery and reforestation), environmental awarenessrising, instable financing, community spirit, type of associations and differences like different financing models, smaller area of reforestation, different ecosystems (nursery techniques), different conservation categories, different initial point, less community involvement in HNTS and less history of the CSO in HNTS. On the one

hand, the implementation of the PES in HNTS is threatened by the missing permission of the administration of the protection area, the change of government who has to ratify the management plan for the area and construction sites like a hydroelectric power dam and an international airport. On the other hand, the PES opens opportunities for learning from the Golfo Dulce and other areas, generating income for the communities, involving enterprise, strengthening the groups unity and expand education centers.

Finally, the participants exchanged ideas about how to improve the implementation of the current project and whether there would be a chance to develop similar projects in the region; they discussed the local participants' use of the knowledge gained during the PES, the improvement of financing mechanisms and the improved involvement of the local community. The results were similar to the ones in the GD workshop.

4.1.3 GN Workshop: Participatory scenario development to plan a PES model

The aim of the GN workshop was to develop participatory scenario planning for a new PES model. Participants had no experience with PES models, so we once again began with the presentation and discussion of the Net-Map-based PES model and the results of the SWOT analysis from the Golfo Dulce region, presented by the local stakeholders of the original region. Based on that workshop, participants discussed opportunities in Nicoya and the challenges facing their mangrove areas, including e.g., agricultural production of products such as sugar cane and pineapples, agrochemicals, waste, soil erosion, the creation of marinas, the invasion of communities and lack of information and education among the people.
In a next step, all participants, including stakeholders from the Golfo Dulce region, worked on scenarios of solutions in the Nicoya regions. One group developed a possible PES model that considered local stakeholders and the specific environmental situation. During this development process, the Net-Map-based model of Golfo Dulce was used and adapted for the specific situation. Stakeholders discussed, for example, whether the CSO could and should play as strong a role as it did in the Golfo Dulce region. Inspired by the discussion of community-based solutions for mangrove conservation a second group of stakeholders started to discuss their own activities focusing on ecotourism development, such as educational tours of mangroves, visits to productive and cultural areas, observation of animals, and canopy tours.

4.2 SNA as a tool for knowledge co-production and social learning in the context of developing locally adapted PES

During the GD workshop, where the SNA results were presented, participants developed new insights about the functioning of the PES, mainly by understanding the money flow and the different financing options available, as well as by understanding the perceived benefits for each actor, which they could compare to their own personal ideas about the functioning of the PES. "I think the analysis of the program was good and allowed us to get to know the views of the most involved actors." (GD workshop participant 1). They also drew conclusions about other actors that might be usefully integrated: "I noticed that we lack actors with property. Like MINAE (Ministerio de Ambiente y Energia – Ministry of Environment, Energy Telecommunications) and the government." (GD workshop participant 6)
Owing to their common understanding of the PES network and the transparent information about the actors and the linkages among them, the participants were prepared to evaluate their PES in the subsequent SWOT analysis. During the GD workshop, participants mentioned – as a strength of the PES – not only the provision of ES such as protection of marine species and air purification but also transparency and communication, the inclusion of the community in conservation issues, the support of trained staff and the development of new knowledge on mangroves and environmental protection for themselves. As weaknesses of the PES, the participants identified actors that were not included or

that provided little help, the instability of financing the model by relying on donations, as well as unresolved environmental problems close to the PES, such as the contamination and sedimentation of rivers and the need for more environmental education in the broader community. The main opportunity observed was that the fishermen's organization had developed a good reputation through the PES, which may help to create similar future projects and to secure more and independent funding for the benefit of the community. The PES is threatened mainly because of its unstable funding situation, which means that the project may stop or be interrupted; it is also threatened by changes in public policies. These threats are due to the unequal distribution of power: activities mainly depend on the donors' willingness to fund. As a consequence, the achievements of the PES, namely the existing network built up by local actors, could be lost.

In the GD workshop, participants built up a network of their own PES and compared it to the original region. In doing so, they not only applied new concepts they had learned about, but even more important, they developed insights about the engaged actors – especially those blocking the implementation – and the exclusion of actors they could have included. Participants stated that they know who these actors are and what aims they have. "I got to know more exactly the fishermen and community´s opinion according to the program and could visualize some challenges that have not been identified before." (GD workshop participant 1) "I learnt that the donor companies do not have the same objective to support this initiative." (GD workshop participant 4) Additionally, ideas for actors that may participate in the PES in the future were mentioned: "Having a wider vision about the problem of sustainable funding of the project and knowing that there are other actors that could contribute more to conservation." (GD workshop participant 12). Finally, they learned about the importance of collaboration in their group: "That being united means to be strong, that different opinions create a variety of ideas for the benefit of all." (GD workshop participant 13).

In the subsequent adapted SWOT analysis, participants could see some elements of the PES, such as actors, were similar, and that, although the financing model was different, the financing was still instable because of the power of the donors. Additional differences between the projects were the ecosystems, which require different nursery techniques; different size areas; and different protection statuses – Térraba-Sierpe is a national wetland and has less involvement from the local community. The CSO also has less history and presence in the region than in Golfo Dulce. The opportunities of the planned PES in Térraba-Sierpe were seen in the learning effects and knowledge transfer from the PES in Osa, using the model for other projects, generating income for the communities, strengthening the group's unity and expanding education centers. Threats were observed in the government, which must give permission for the reforestation, and in huge infrastructure projects such as the hydroelectric power plant and the international airport, which will affect the region's development.

In the HNTS workshop, the main learning effect occurred as a result of participants reflecting on their own state of action after having received new input from the fishermen from Osa and after having understood their PES. The overall result of the discussion was that ideas already exist and are partly implemented but that there is a missing link among the individual projects. The CSO will aim to fill this gap. Participants mentioned that they understood that group organization is necessary: "I learned a lot, you better work in group and you have to be organized to work in a better way/more effectively/efficiently." (HNTS workshop participant 4) and that they got to know the CSO better: "Knowing more about the CSO and about the Blue Carbon Project." (HNTS workshop participant 2). They also stated that they learned about PES as a new conservation model, which may be replicated in different contexts. "I learned that there are very motivated people and that there are other possible models." (HNTS workshop participant 1). "That the Blue Carbon model can be easily replicated." (HNTS workshop participant 6)

In Nicoya a PES I still to be developed. In consequence, participants had to be informed about possibilities to create new project. This is reflected in the statements about what people learned: “Getting to know new projects in this community and how to organize a new project.” (GN workshop participant 1) and “Creating ideas to propose environmental projects.” (GN workshop participant 3). For the participants, it was important to get into contact with people and institutions that have the knowledge and interest in setting up new projects in the region: “The most important thing was to know people and institutions that could be strong actors to establish projects for local development.” (GN workshop participant 8). Similar to the GD and the HNTS workshop, participants learnt that collaboration is essential: “That it is important to work in group.” (GN workshop participant 10).

Science-practitioner cooperation

Because the participants in the GD workshop were local stakeholders involved in the Communitarian Blue Carbon Project, most of whom were interviewed in the single Net-Map interviews, they were able to better understand the research process in which they had taken part while giving their individual Net-Map interviews. There was transparency in how the researchers were using the information they were offering, and through the presentation of the preliminary results, they obtained valuable information in return.

During the workshop, the local stakeholders evaluated their PES and transferred their knowledge and experiences to other local land users, while the researchers introduced the results of the Net-Map interviews and facilitated the workshop process. However, during the GD workshop, one fisherman took over the explanation given by the researcher. In the subsequent workshops, the presentation of the network model was no longer given by the researchers but by the fishermen from the original case study, who explained the functioning of the PES in their region as well as the SWOT results from the GD workshop to the workshop participants. This made the fishermen feel extremely proud and demonstrated that they owned the process.

These three fishermen from the GD workshop, who accompanied the Net-Map interviews and all other workshops, made some deeper progress as they not only reflected individually or with their peers on the PES but also imparted their knowledge to broader regional and international audiences. First, during the Net-Map interviews, they reflected on their PES network. Then, they applied their deeper knowledge to the analysis of the PES with the SWOT methodology. Finally, they imparted their experiences and knowledge to the participants in the other regions (see table 2). At the end of the overall research project, they had so much knowledge and confidence that they even dared to talk about their PES at a large, international conference in Costa Rica.

Table 2: Overview of science-practitioner cooperation

	Objectives	Use of Net-Map tool	Role of local land users – fishermen	Role of social researchers	Outcomes
Net-Map interviews	Understanding the structure, actors, and power relations of an existing PES	Transparent information gathering	Providing information on their network and reflecting on it	Conducting social network analysis	Social network of the PES model to be used for discussion in the workshops.
GD Workshop : Participatory evaluation of an existing PES model	Reflecting on and evaluating the existing PES to improve the PES	Explaining the network map of the PES to reach a common understanding of its functioning	Reflecting on their network to obtain a basis for thinking about further improvement and applying their wider knowledge	Presentation of research results, facilitation of group discussion accompanying social scientific research	Agreement on PES model and its social network; identification of strengths, weaknesses, opportunities and threats of the PES; generation of new ideas how to deal with the weaknesses; identification of ES, beneficiaries and damagers as input for the amplification of the social network.
HNTS Workshop: Participatory planning process for PES development and implementation	Obtaining new knowledge of networks for PES in order to develop and implement another PES scheme	Reflecting on the network map and transferring the knowledge to another PES network	Imparting their knowledge and explaining the network to another community, and helping them to reflect and adapt their own PES network	Facilitation of group discussion, accompanying social scientific research	Identification of difference between the GD and the HNTS model; identification of opportunities and threats of the planned PES; generation of new ideas how to deal with the weaknesses.
GN Workshop: Participatory scenario development	Obtaining new knowledge of networks for PES to develop scenarios for future PES schemes	Reflecting on the network map and thinking about networks for future PES schemes.	Imparting their knowledge and explaining the network to another community, and helping them to reflect on their network possibilities in order to create a PES scheme	Facilitation of group discussion, accompanying social scientific research	Knowledge on a social network for a PES model; identification of regional challenges for a PES model; development of a Net-Map; development of project ideas for ecotourism.

Source: Own elaboration.

5. Discussion

The results of our study show that SNA can be a tool used for participatory planning procedures to develop and implement locally adapted PES, as well as a tool for knowledge co-production and social learning in the context of developing locally adapted governance models such as PES.

5.1 SNA as a tool for participatory planning procedures to develop and implement locally adapted PES

The additional value of the SNA for implementing PES is that it reveals the power relations of the PES design and makes processes and links transparent. With Net-Map, this is done during a participatory process that also enhances learning processes. In addition to formal institutions, informal institutions – such as norms, values, traditions, and actors´ hidden motivations – also become clear and can be handled (Mann et al., 2015). On the basis of this information, actors´ interests and values can be balanced openly.

The SNA was important in order to create a common understanding about the structure and the functioning of the PES. This understanding supported the consolidation of transparency and trust not only amongst the involved stakeholders but also amongst the researchers, interviewees and workshop participants, as we presented some of our research results at the workshops. Transparency mainly revealed funding structures and distributional effects, which is important for negotiating trade-offs between different objectives (Mann et al., 2015). In discussing the improvement options for the PES models and taking a view towards the future, stakeholders managed to apply their new insights during the workshop and to adapt to a changing context. The power relations of actors regarding knowledge, meaning and inequalities became clear. Thus, we could make transparent “how PES interventions are adapted locally through the exercise of both visible and invisible power, and to how this shaping is always socially located” (Van Hecken et al., 2015: 123) and “shaped in the interplay between deliberate design, every day practices and relationships and societal processes”(Cleaver, 2012: 171). It became

clear that PES is not only “an instrument to better align social interests under any externally imposed value system, but should rather be understood as a social construction that is mediated by local realities and how these realities may influence the form and terms of negotiation and design of solutions” (Corbera et al., 2007). In this way, it can foster inclusive, transparent and adaptive processes of political negotiation for ES governance. Though this does not mean that PES are a panacea for environmental protection or the only governance solution for ecological problems. They are still a contested approach with pros and cons but with their properties being transparent participants have better options to design or adapt PES to their needs and values.

We used the method to present a snap-shot of the PES model and make the social structures transparent. In case of GD and HNTS, we could not turn back time to start the PES design from zero. Therefore, the underlying power relations had to be accepted and could only be revealed. In future research or before starting new PES project we recommend undertaking SNA to discuss relations, inclusion and exclusion of actors in advance.

Power in the GD network has been measured with influence towers during the individual interviews. The results showed similar influence of the CSO and the fishermen association, both in its respective field: the fishermen association at the local level, mediating between the fishermen community and the CSO, and the CSO at the national and international level, mediating between fishermen association and donors. As both were influential actors, power relations were balanced, so we had no concerns to include all relevant actors in the workshop. There was no climate of fear during the workshops that hindered people to express themselves openly. Weaknesses of the project in terms of financing mechanisms and inclusion of the local communities beyond the fishermen were discussed openly, too.

Using the Net-Map results in three workshops, we demonstrated how SNA can foster the PES development process. Analysis of a network is useful to identify important actors that should ideally be included in the PES design and in the implementation process. Reflections on the network visualize the social capital that communities can rely on and the power structures that influence PES planning. Workshop participants in Osa identified the fragility of the financing mechanisms while participants in Térraba-Sierpe observed the importance of governmental support due to the protected status of the area; they also observed the still-fragile social capital and involvement of communities in protection issues. Participants in Nicoya observed they would have to include agro-business and would need someone to connect the existing initiatives. In this way, the tool helped to visualize governance structures and brought together specific actors from different spatial levels and societal sectors; it addressed challenges of ES governance such as actor heterogeneity and institutional diversity.

5.2 SNA as a tool for knowledge co-production and social learning in the context of developing locally adapted PES

The specific goals of the workshops were to develop a common understanding of different actors and their interactions in the PES model of the original case study, as well as to identify the strengths and weaknesses of the project. Most of the involved actor groups were present at the discussion, and actor groups that would be helpful to include – or to include to a greater extent than before – could be identified. Challenges and suggestions for improvements, as well as ideas for new projects, could be exchanged. Especially, the participants of the HNTS and the GN workshops learned about the structure and the functioning of a PES. Learning processes were created along with the joint development of specific network situations, thus helping to develop a PES model adapted to each region. The stakeholders focused on thinking about possible important actors and on financing structures for their programs, and they could make comparisons to the main actors and financing structures in Golfo Dulce. The workshops made the facilitation of collaboration possible, as they engaged representative stakeholders, facilitated shared and iterative learning and produced a boundary object that is a

product of collaboration which is adaptable to different viewpoints: the network maps (Schuttenberg and Guth, 2015, Hauck et al., 2015).

In terms of knowledge co-creation the workshops however may be biased as we as researchers structured the activities to our way of thinking, framing the CBCP as PES and using the Golfo Dulce Program as successful example for the other two case study areas. This left only little space for the participants in the new regions to appeal to their own specific knowledge frames. This influence of knowledge and power structures on participation have been observed and criticized in literature recently (Kolinjivadi et al., 2017, Craps et al., 2004, Büscher, 2014).
In our study, the idea of PES as a useful model was not challenged. Though, we did not use the word PES during the workshops and also the NGO does not use it in the local context, but emphasizes the educational and awareness rising part of the CBCP to enable community empowerment instead of the exchange of money for ES provision. A deeper look into the CBCP´s setting up process would be necessary to reveal how knowledge frames and power relations influenced the program design from the beginning on. This is why we would recommend integrating SNA for analyzing knowledge and power relations at the earliest stage of a PES design process.

One immediate outcome of the collaboration process was social learning. The exchange among the three regions not only brought stakeholders together but also generated different forms of knowledge about mangrove conservation. The different characteristics of the ecosystems became clear and could be discussed within the different stakeholder groups, which included conservation experts from different CSOs and universities as well as local fishermen who knew the economic value and societal aspects of the ES provided by mangroves and could give feedback on the quality of the provided ES because they monitor the area. The SNA therefore proved useful for the co-generation of knowledge in ES governance and helps this knowledge to influence decision making and be turned into practice (Mann et al., 2015). Thus, the creation of influential knowledge that could be passed on to other regions was an intermediate outcome of the process.

A second immediate outcome was the empowerment of the local actors. In addition to providing knowledge and understanding of useful elements necessary for PES design, the Net-Map tool also strengthened the stakeholders´ motivation to participate in a PES. The understanding of their PES model created ownership, which became visible in their proud explanations of the model to the other communities. In the long run, experience led to empowerment, as the communities acquired more knowledge to establish PES on their own and even initiated social development projects such as sustainable tourism or oyster farming on their own, without the intense intermediation of the CSO. By using the Net-Map results during the workshops, we contributed to the building of new networks and to strengthening the already existing networks (Bodin and Crona, 2009).

The ultimate outcome of the process was action: the stakeholders even formed something like a community of practice (Wenger, 2000) for designing new projects and created synergies amongst stakeholders within and between the regions. In the original region, the fishermen's association initiated activities with the cooperation of tourist guides: they began to offer eco-tourism excursions in the mangroves, where they can share their knowledge and sensitize tourists to ecosystem services. In a similar way, female fishermen planned and adapted an oyster farming project from Nicoya to the Golfo Dulce region to earn additional income. These projects were planned without the CSO and demonstrate the empowerment the stakeholders had previously lacked: they are now able to initiate new income sources and ideas on their own. The mutual learning that took place according to participants´ final statements supports the development of adaptive governance structures, which can address specific complex and uncertain local social-ecological systems (Folke et al., 2005).

These outcomes were not due only to the conducted workshops but benefitted from a long during work of the CSO with the fishermen associations and communities. Especially, the empowerment is

owing to the CSO´s work. However, our project facilitated the knowledge and experience exchange between the three case study regions, financially as well as methodologically. The CSO was waiting for such an opportunity.

The study just reflects one moment in time. Unfortunately, because of the end of the research project, no ex-post assessment or follow up or time-line interviews have been possible so far. However, the PES model still exists in Golfo Dulce, thanks to new funds. The project in Térraba-Sierpe could be implemented after administrative approval and with the support of new donor institutions, and also in the Nicoya region a number of similar PES models could be initiated.

Additionally, the Net-Map analysis revealed differences among the regions other than the different implementation statuses of the PES. It became clear that where local people are weakly connected to each other, a strong CSO is needed. The fishermen themselves identified this as the social capital they need to build up a PES system. In Osa, there is an abundance of available and active social capital – in the stakeholders´ opinion, an extension to the local communities would be desirable. The stakeholders are strongly empowered; however, communities are less organized in the HNTS region, and cooperation has to be established and enforced. Additionally, communication with the pivotal manager of the protected area is poor, and different CSOs are fighting for leadership of the area. In Nicoya, social capital is available and well organized independently of the CSO, whose position is not as settled as in the other two regions, as the field station remains to be developed there. In Térraba-Sierpe, the CSO has a better position, but it is different because there is no field station; instead, CSO members who visit frequently, or people from the region, are invited to activities at the Osa field station, although that requires a two-hour drive. Finally, there are differences in the degree of cooperation and trust among the stakeholders in general. In a follow-up study, it would be interesting to measure how and to what extent social capital can be built and power structures can be changed during the development and implementation of a PES. This is consistent with the request for long term studies to document the processes and progress of ES governance: “From a methodological perspective, these challenges imply a need for multidimensional long-term empirical studies into the complex and place-based workings of power (related to meaning and representation) and into the ways in which ideologies, beliefs and norms shape decision-making.” (Van Hecken et al., 2015) Additionally, changing structural characteristics like changes in power relations or financing mechanisms may be considered by those types of studies (Bodin and Crona, 2009).

5.3 Methodological limitations

Regarding the individual Net-Map interviews it would have been great to do similar interviews in the HNTS and GN regions as well. The tool is an elaborate data collection tool which requires a lot of time and resource. As we were interested in using the network of the implemented PES model for discussion in the workshops and as we did not aim to compare the different regional networks, we only did a deeper analysis of the social network for GD. Further, in GN there was no existing PES model we could have drawn the network for. Without resource restrictions of time and money we would probably have decided in a different way.

Undertaking research in combination with workshops has its limitations, as it reveals – within a group – confidential information given in personal interviews. However, as the information is presented to the group in an aggregated way, it is not possible to trace the different pieces of information to specific actors, and confidentiality is still in place. In consequence, this limitation should be accepted as part of creating a transparent process. This was possible due to the existing trust amongst the actors, which could be identified during the Net-Map interview process before information was shared during the workshops.

Another limitation is that, because of time conflicts or other duties, it is not always possible to gather all involved stakeholder groups at one table. All stakeholder groups involved in PES were only present at the workshops in Osa, where the PES was successfully implemented. In Térraba-Sierpe and Nicoya,

stakeholders from the government – mainly the respective administrations of the protected areas – were missing or only participated for a very short time, as they had to attend to work-related issues. It was difficult to attract people from the business sector to this type of workshop; a fact that increases the importance of the Net-Map interviews, which can reveal the business perspective.
Additionally, when preparing the network map used in the workshop, we did not exploit the whole range of SNA Net-Map offers but presented only a small cutout of the whole picture in our first, handmade analysis of the Net-Map. We did not have the time to present a computer-processed map of the social network; we did not present measures such as centrality or influence towers to the stakeholders which would have made it possible to discuss further power relations. For our purposes, to assess the transferability and adaptability of a PES model, the presented information was fine.
A further consideration is that for the scenario development of PES design, actors must have a certain level of openness and creativity so that the resulting PES design is not merely a copy of the first net-mapped PES example. This is something that can hardly be controlled and partly depends on the personalities of the participating actors. Researchers should perhaps consider which additional exercises could be included in the future to stimulate this required creativity.
Finally, reflecting on our role as action researchers, we had to closely collaborate with the CSO to obtain access to the field and set up the workshops. This may cast doubt upon our scientific independence. However, from the beginning, the CSO stated that they were interested in our work being independent as, similar to suggestions from an external consultant, our findings would support them in improving their work.

6. Conclusion

In this paper, we demonstrated how empirical data from social sciences can be combined with the participatory planning processes of PES models. SNA and the participatory Net-Map tool visualize governance structures and bring together specific actors from different spatial levels and societal sectors. This approach helped to create a common understanding of the PES structure, the creation of ownership, and the consolidation of transparency and trust amongst the participants as well as in the reflection on the existing social capital necessary for the implementation. SNA supports the design of inclusive and adaptive processes that shape institutions, choices, design and implementation of policy instruments such as PES. The additional value of the tool is that it makes these processes transparent by generating knowledge during a participatory process and helps to balance the actors´ interests and values. By enhancing social learning processes, this tool improves local actors' capacity for participatory processes.

In combination with workshops, the method and the tool can be used as a platform for co-generation of local and scientific knowledge and to support cooperation between scientists and political decision makers, thus helping to turn knowledge into practice. Mutual learning amongst actors strengthens the ability to handle the complexities and uncertainties of social-ecological systems and fosters forms of adaptive governance. Broader stakeholder inclusion allows the amplification of the social network, starting cooperation in new projects, and the better integration of institutions into society, while revealing informal institutions strengthens mutual trust.

7. References

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