

Research paper

Important Bridges for Implementing Socio-Ecological Management in the Adiri Community of Pingtung, Taiwan after Typhoon Morakot

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【 Summary 】

Studies of adaptive management of natural resources are increasingly focusing on the role of bridging organizations that can connect various actors and knowledge systems through some form of strategic bridging process. However, empirical investigations of the process of bridging and the conditions that foster collaborative learning are limited. In this paper, we examined how the idea of sustainability can be used to build bridges among stakeholders and how participatory action research (PAR) can bridge academic research and practical actions to facilitate communication and collaboration among multi-level partners to deal with abrupt changes and uncertainty in socio-ecological systems. We focus on the process and strategies for post-disaster recovery and sustainable development of the Adiri community of the Rukai people living in Pingtung, Taiwan after the 2009 Typhoon Morakot. We found that the concept of sustainability provided common ground for intercultural communication among the Adiri community, university partners, and government agencies. More importantly, PAR offered a practical framework to bridge gaps between ideas and actions. The cycles of collaborative observation, planning, action, and reflection in PAR could be understood as processes of social learning for all partners to deal with new problems that emerged. Constant communication and tangible results of action taken were crucial for building and maintaining trust.

Key words: adaptive management, bridging organization, sustainability, participatory action research.

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研究報告

搭起觀念及實作方法的橋樑： 阿禮部落在莫拉克風災後之社會—生態系統管理

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摘要

近年來自然資源適應性管理相關研究愈來愈關注「橋樑組織」在連結不同社會行動者及知識系統上扮演的角色，然而關於這些連結產生的過程及條件，仍缺乏足夠的實證研究。本研究目的在於檢視「可持續性」概念及「行動研究法」如何分別作為觀念上與實作方法上的橋樑，可用於促進不同行動者和組織之間的溝通與合作，並用以因應社會—生態系統中的變化及不確定性。本文以屏東縣霧臺鄉阿禮部落在2009年莫拉克風災後的重建歷程與策略為例，說明可持續性這項觀念如何協助阿禮部落、大學及公部門之間的溝通產生交集。更重要的是，行動研究法提供一個實作架構，可以搭起理念及行動之間的橋樑。本研究認為行動研究法中的觀察、策劃、行動及反思的循環，可視為所有參與者一同做中學的歷程，藉以共同解決不斷出現的新問題。而時常的溝通及行動所創造的具體成果，對於互信的建立及維持是相當重要的。

關鍵詞：適應性管理、橋樑組織、可持續性、行動研究。

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INTRODUCTION

Linking diverse actors and knowledge systems across levels poses one of the greatest challenges in adaptive management of natural resources (Ostrom 2005, Kowalski and Jenkins 2015). Increasing attention has been paid to the role of bridging organizations in environmental management outcomes and nurturing resilience in socio-ecological systems through facilitating interactions among actors or groups. This article aims to empirically investigate the role of “bridging” (both as a theory and a methodology) in adaptive management of socio-ecological systems in a post-disaster context.

The aftermath of the 2009 Typhoon Morakot posed a monumental challenge to residents of Adiri, an indigenous community

of Rukai people living in Pingtung, southern Taiwan. Most Adiri residents permanently relocated from the mountain to the plains, while some community members preferred to stay and re-establish their lives in their homeland, in which they have profound connections and roots to their ancestors and cultural history. In the face of abrupt changes and uncertainty following the disaster, collaboration among various organizations at different levels became essential to sustain the social capacity to respond to environmental changes. We focused on the process and strategies for facilitating collaboration among the Adiri community, governmental agencies, research institutes, and non-governmental organizations for enhancing socio-ecological resilience after

Typhoon Morakot.

In this paper, we first discuss the definition and importance of bridging organizations in adaptive environmental management, and how the concept of sustainability and participatory action research can serve as bridges conceptually and methodologically to link various actors and knowledge systems. We then present an empirical case study of post-disaster ecotourism development of Adiri and examine how bridging was implemented in practice.

The role of bridging organizations in adaptive environmental management

Studies of natural resource management have increasingly used the concept of socio-ecological systems to highlight linkages between social and ecological systems; i.e., humans must be seen as a part of nature rather than being separate from nature (Berkes and Folke 2000). Socio-ecological systems are characterized by inherent unpredictability caused by nonlinear interactions among processes; yet management decisions must still be made (Allen et al. 2011). Adaptive management of natural resources has been proposed as an effective strategy for dealing with the complexity and uncertainty of socio-ecological systems (Berkes 2009). Adaptive management emphasizes iterative processes of learning-by-doing and the decentralized exchange of ideas and experiences among stakeholders based on the philosophy that knowledge is always incomplete (Folke et al. 2005, Allen et al. 2011). Bridging organizations, which can be defined as entities that connect various actors and knowledge systems, play an important role in facilitating such collaborative learning (Hahn et al. 2006, Olsson et al. 2007).

Bridging organizations vary in size, scope, and formalization, and range from multi-stakeholder management boards to re-

search institutes and local non-governmental organizations (Berkes 2009, Crona and Parker 2012). Moreover, bridging organizations were suggested to provide an arena for identification of common interests, conflict resolution, vertical and horizontal collaboration, sense making, social learning, and trust building (Hahn et al. 2006, Olsson et al. 2007, Berkes 2009, Crona and Parker 2012, Berdej and Armitage 2016).

While the role of bridging organizations has gained wide conceptual appeal, the process of bridging and the conditions that foster communication are little studied. There is insufficient understanding of how collaborative learning and trust building among various stakeholders are shaped by broader political and socioeconomic contexts. A conceptual and methodological toolkit for bridging in support of adaptive environmental management is therefore badly needed.

Using sustainability to build bridges among stakeholders

Typically, following natural hazards and disasters, many recovery projects and policies are developed in response to urgent pressures to quickly reduce risks and rebuild communities. While disaster recovery should be marked by urgency and speed, long-term reconstruction must be cautiously designed to facilitate the sustainable development of communities and their ecology (Berke et al. 1993, Ingram et al. 2006). To deal with abrupt changes and uncertainties inherent in socio-ecological systems, such as natural hazards or socio-economic crises, it is important to find common ground for various stakeholders with multiple knowledge systems and interests.

Sustainability can act as a bridge or “boundary object” (Leffers 2014) that facilitates interdisciplinary and intercultural discussions of strategies for adaptive environmental

management and disaster recovery. The concept of sustainability, which encompasses environmental, social, cultural, economic, and institutional dimensions (Chen 2009), helps bring together the objectives of conservation, disaster recovery, and long-term development in an integrative way.

Environmental sustainability can be defined as the maintenance of important environmental functions and the capacity of the capital stock to continuously provide these functions (Ekins et al. 2003). For communities that rely on natural resources, environmental sustainability is inseparable from social, cultural, and economic dimensions of sustainability. The communities' social bonds and norms, cultural values, and production activities associated with natural resource management are also vital for maintaining ecosystem services and biodiversity (Pretty 2003, Pretty et al. 2009, Morelli 2011).

While the maintenance of environmental, social, cultural, and economic dimensions of sustainability requires various types of institutional support, institutional sustainability is also crucial to sustainable development instead of being an add-on to other dimensions of sustainability (UN-DESA 2006). The institutional dimension of sustainability can be understood here as the maintenance of institutional capacity and a willingness to integrate sustainability into mainstream policies and coordinate human interactions to achieve sustainability goals (Pfahl 2005, Tavanti 2010). Continuous government efforts at the local and national levels are particularly important to meet needs that cannot be met by community action and to establish a stable environment within which communities can sustain their initiatives (Dale and Newman 2010).

Interpretations of sustainability and strategies for achieving it can differ among indigenous and non-indigenous societies (Throsby

and Petetskaya 2016). Nevertheless, there are shared understandings of sustainability across disciplines and diverse cultural groups. Such concepts help bridge the gaps between natural and social worlds, and between legislation and daily realities. Determining how to implement the concept of sustainability requires a methodological approach that can bring together theory and practice.

Participatory action research (PAR) bridges research and action

PAR is a research approach that emphasizes collaboration, action, and knowledge generation among practical researchers, communities, and other social actors to solve problems that affect communities and the broader society (Greenwood et al. 1993). It is often used interchangeably with other terms, such as action research and community-based research (Olshansky et al. 2005). Instead of conducting a study “on” or “for” communities, PAR investigators conduct a study “with” community members to integrate their perspectives and input into all stages of the research process. The goal of PAR is to meaningfully engage with the world through participation and action that is oriented toward positive social change (Baum et al. 2006).

A vital feature of PAR is that researchers build an equal partnership with community members to address social or community issues through continuous cycles of collaborative observation, planning, action, and reflection (Olshansky et al. 2005, McIntyre 2007, Kindon et al. 2007). First, the research team and community members meet and discuss their views and concerns through their observations. After identifying issues of concern, the research team and community members develop strategies for problem solving by constant communication and collaborative learning. Action refers to the actual imple-

mentation of the strategies developed in the planning stage. The reflecting moment in PAR, which refers to the analysis and evaluation of the action results, is often intertwined with the acting moment. The four moments in PAR occur interactively as there may be several cycles involved (Olshansky et al. 2005).

PAR is a method that can bridge gaps between the theory and practice of sustainability. The collaboration and knowledge co-production highlighted in PAR is consistent with the principle of adaptive management of socio-ecological systems, which emphasizes the importance of learning-by-doing (Berkes 2009). The research team in PAR can serve as a bridging organization that facilitates communication and collaboration among communities, governments, and other social actors across levels.

Using the Adiri community in Pingtung, Taiwan as a case study, we conducted PAR by establishing a partnership with Adiri and used ecotourism revitalization as a strategy for disaster recovery and sustainable development after the community was hit by Typhoon Morakot in 2009. The following sections of the paper demonstrate how the Community Forestry Laboratory (CFL) at National Pingtung University of Science and Technology (NPUST) functioned as a bridging organization that facilitated collaboration among residents of Adiri, the Taiwan Forestry Bureau (TFB), and other governmental organizations and NGOs through PAR.

MATERIALS AND METHODS

Research setting

Our research focused on the Adiri community of the Rukai people in Pingtung County, Taiwan. Prior to the 2009 Typhoon Morakot, the Adiri community was located upstream on the North Ailiao River on the

northwestern side of Wutou Mountain. The Adiri was the highest village in Wutai Township of Pingtung County, located at an elevation of 1200 m. There were approximately 350 residents in Adiri. Adiri is surrounded by mountains and forests that have great biodiversity. The traditional social structure of the Rukai is a hierarchical system that is divided into a chieftain, nobles, and common people (Qiao 2001). Adiri's natural and cultural heritage has remained intact partly due to its remote geographic location.

Adiri Village consisted of the upper settlement (Balriu) and lower settlement (Wumauma). In early times, Balriu was Adiri's primary residential area and Wumauma was their farmland. Wumauma later became a settlement due to population growth. Like other indigenous communities in Taiwan, about 85% of the 300 Adiri residents had migrated to cities and suburbs to access education, healthcare, and job opportunities, while others, particularly the elderly, stayed on their homeland as subsistence farmers and/or seasonal forestry laborers hired by the TFB (Abaliwsu 2012, Taiban 2014). Since most of Adiri's traditional lands have been designated as state-owned forests and protected areas, development of the Adiri community is inseparable from state forest management.

In a context wherein access by Taiwanese indigenous peoples to forest resources is restricted by complex legal constraints, ecotourism has been promoted by both the government and academia as a more appropriate way to carry out community-based forest management near protected areas because it is non-extractive and provides economic incentives for communities to engage in conservation. Since 2008, the Adiri community has collaborated with Taiwan's Pingtung Forest District Office and the CFL at NPUST to develop community-based ecotourism and had

established some degree of trust among these groups prior to the 2009 Typhoon Morakot. While the ecotourism development efforts were proceeding as planned in the first year, Typhoon Morakot hit southern Taiwan in August 2009 and devastated many local communities, including Adiri.

Methodology

We adopted a PAR approach to investigate and respond to the needs associated with post-disaster recovery and sustainable development in Adiri. PAR emphasizes the active participation of researchers and participants in the co-production of knowledge, planning, and implementation of actions that leads to social change (McIntyre 2007). In this study, CFL at NPUST served as a bridging organization that fosters communication and collaboration among Adiri residents, the TFB, and other governmental and nongovernmental organizations. Through continuing cycles of observation (problem diagnosing), planning, implementing action, and reflection, we (members of the CFL) and Adiri worked together to find effective solutions to problems and issues experienced by community members in the context of post-disaster reconstruction.

The recovery efforts during the 2 years following the disaster were critical for the Adiri community, because they could have significant impacts on the confidence and long-term developmental trajectories of the community. We collected data for this study from January 2010 to February 2012 by participant observations, informal interviews, and focus group interviews.

We participated with community members in planning and implementing Adiri's post-disaster recovery. Additionally, we made ethnographic observations of Adiri's everyday activities and conducted informal interviews with community members, which enabled us

to gain a better understanding of the research context (Stringer 2013) and establish a clearer picture of the problems associated with disaster recovery from the community members' perspectives.

Focus group interviews are ideal for exploring participants' experiences, opinions, concerns, and wishes in relation to a collective identity and tasks (Kitzinger and Barbour 1999). We conducted 15 focus group interviews during working meetings for post-disaster recovery. In total, 19 people were involved in these focus group interviews. The interviewees were key individuals in the ecotourism development process, including local leaders of Adiri, community members involved in ecotourism, government officials, NGO workers, and members of the CFL.

Throughout the course of our research, continuous review, reflection upon, and modification of actions were integral aspects of the data collection process. Researchers analyzed each interview separately, and then conducted an analysis across all interviews. From the research design, data collection, to data analysis, emerging findings were compared to relevant literature to ensure rigor and plausibility of this research.

RESULTS

From 2010 to 2012, the process of Adiri's post-disaster reconstruction can be divided into three primary PAR cycles: I) post-disaster ecological monitoring, II) reconstructing sustainable livelihoods, and III) restoring community solidarity and safeguarding the ancestral land. The PAR cycles are presented here in chronological order of their emergence. These cycles were initiated by problems, issues, or a desire for change identified by the Adiri community.

Each research cycle includes the follow-

ing moments: observation and problem identification, planning and implementing action, and reflection. In practice, some moments of the 3 PAR cycles occurred simultaneously and were intertwined with each other. The iterative cycles fed back into and changed what subsequently occurred in the process.

Cycle I: Post-disaster ecological monitoring

1. Observation and problem identification

After Typhoon Morakot, although the lower part of Adiri was seriously devastated, its upper settlement was only slightly damaged. Based on policies of “conservation of national lands,” some typhoon-affected areas were judged to be geohazard-prone areas, which were off-limits to residents. During the process of delineation of “environmentally sensitive areas,” the Adiri community had reached a consensus that only lower Adiri would to be relocated as a whole, while households of upper Adiri could decide on an individual basis

whether to relocate. However, consultations with Adiri and other affected indigenous communities were rarely done. As a result, the government delineated the entire Adiri community an environmentally sensitive area. Most residents were forced to relocate away from their ancestral lands in the mountains to permanent houses in Changzhi Township (Changzhibaihe Village) on the plains, which is outside their traditional territory and much closer to urban areas (Fig. 1), but 4 households insisted on returning home and safeguarding their ancestral lands.

In the policies and laws for disaster recovery, forced relocation of communities is viewed as an unavoidable consequence caused by environmental factors; however, little attention was paid to the fact that displacement alters the fundamental relationships people have with their environments. The attachment to lands gave Adiri residents their identity and a sense of belonging and obliged some community members to return home. Community members of upper Adiri

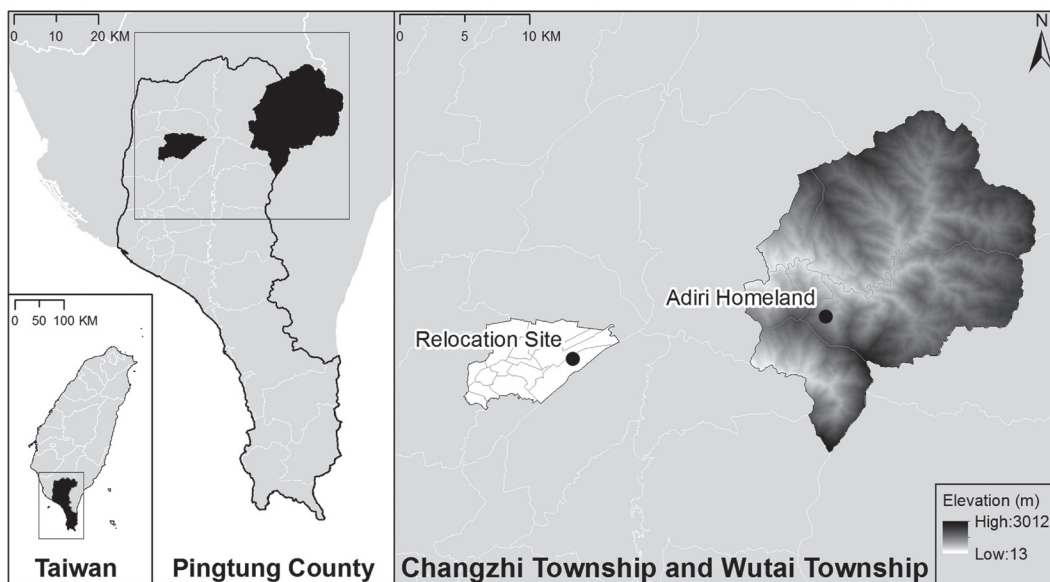


Fig. 1. Map of the Adiri homeland in Wutai Township (right) and the relocation site in Changzhi Township (left).

sought advice from the CFL to find legitimate reasons for returning to their typhoon-hit homeland. Both Adiri residents and the CFL believed that Adiri residents' return to look after their homeland was an act of safeguarding the sustainability of socio-ecological systems. Determining how to adapt to the post-disaster environment and rebuild lives and livelihoods in the Adiri ancestral land was a primary problem that needed to be addressed.

2. Planning and implementing action

To gain support from and continue the partnership with the TFB that began in 2008, the CFL and Adiri developed a plan regarding community participation in ecological monitoring of the protected area on the Adiri ancestral land after Typhoon Morakot. This strategy was strongly supported by the TFB as the idea of sustainability served as the common ground for the continued collaboration. In 2010 and 2011, the partnership between the Adiri community and the CFL at NPUST was supported by the project "Community participation in monitoring of protected areas after Typhoon Morakot: a case study of Adiri community in Wutai Township" funded by the TFB. The total budget for the 2-year project was NTD 4.12 million (\approx USD 136,000).

In addition to conserving the Adiri culture which is closely attached to the land, from the TFB's view, the community members' continuous patrolling and monitoring of the forests prevented illegal logging and hunting and thus perfectly met conservation objectives. The 2-year project of patrolling and monitoring of protected areas funded by the TFB also provided timely financial assistance to community members. From the onset, the CFL adopted a PAR approach that bridged academic science and practical actions in close collaboration with Adiri residents. Data collected from ecological monitoring were

also used to inform the development of ecotourism in subsequent stages of recovery.

The objective of ecological monitoring was to gauge the impacts of the disaster on the environment and track biodiversity changes for implementation of conservation actions. In February 2010, several Adiri community members were recruited as monitoring personnel. To help community members gain basic skills and knowledge of ecological monitoring, the CFL held a series of training sessions for the community members, including GPS surveying; investigation of plants, animals, and their habitats; development of ecotourism itineraries; and improvement of interpretation techniques.

3. Reflection

Ecological monitoring of protected areas in a post-disaster context helped Adiri residents get back on their feet. This project not only fulfilled the biodiversity conservation objectives of the TFB but also helped community members rebuild their relationship with ancestral lands and meet their economic needs. However, to achieve economic sustainability, it was also important to rebuild the ecotourism businesses developed prior to the disaster. More personnel from Adiri were needed to develop ecotourism.

Cycle II: Reconstructing sustainable livelihoods

1. Observation and problem identification

After initial planning and training, post-Morakot Adiri ecotourism was officially launched in April 2010. However, there were 2 problems that needed to be overcome to make the socio-ecological systems in the ecotourism setting more resilient. First, there was insufficient staff for selling handicrafts, preparing food, and providing accommodations.

For many Adiri residents, it was difficult to participate in reconstruction work in their ancestral land while their lives at the relocation site remained unstable. Additionally, many Adiri community members at the relocation site had been recruited as temporary workers by other post-disaster recovery programs run by Taiwan's Ministry of Labor. The other problem was how to develop alternative livelihoods when visitors' travel to the area was not safe in the rainy season.

2. Planning and implementing action

To recruit more community members to participate in ecotourism development, the CFL participated in every community meeting to communicate with community members and explain the potential of ecotourism to create employment opportunities and ecological sustainability in the post-disaster context from both theoretical and practical perspectives. Through constant communication, CFL's promotion of ecotourism won the support of local leaders of Adiri and other community members.

Ecotourism in a post-disaster context must particularly take environmental conditions into account. One year after Typhoon Morakot, even a small amount of rainfall could cause road closures due to landslides. To adapt to an unstable environment, ecotourism management was implemented in a more rigorous way. When encountering rains or hazardous road conditions, all Adiri ecotourism activities were suspended. From January 2010 to February 2012, the Adiri community hosted 182 tourists. The tourist season was limited to only 3 months per year.

In the face of changing environmental conditions, Adiri residents collaborated with the CFL to develop strategies for economic diversification. For example, Adiri residents produced cultural handicrafts, and developed

packaging and marketing strategies for their red plum products as alternative strategies for income generation. To work within the carrying capacity limits of ecotourism, Adiri residents also made alliances with surrounding indigenous communities to co-develop 1- and 2-day tour packages. After seeing tangible improvements in their socioeconomic conditions, more and more community members developed trust in the partnership with the CFL and relevant government agencies.

To improve the operations and services of the Adiri's community-based ecotourism business, the CFL helped design codes of practice, working timetables, standard operating procedures, and mechanisms for allocating ecotourism benefits from Adiri's ecotourism. All rules and instruments were established with the community's active participation and engagement. Codes of practice for ecotourism were especially critical for controlling the impacts of tourism on environmentally fragile areas in the post-disaster context.

Another strategy for sustainable economic development was the greater use of renewable energy. In March 2011, the National Taiwan University Building & Planning Foundation helped the Adiri community set up a solar power system. This renewable energy source not only meets Adiri's emergency needs but can also be incorporated into their environmental interpretation content. The CFL also helped mobilize resources from private corporations and other NGOs for the Adiri community to revegetate the local landscape and rebuild wildlife habitats. These revegetation efforts simultaneously enhanced the local biodiversity and the attractiveness of Adiri's ecotourism product.

3. Reflection

The development of environmentally and economically sustainable ecotourism

businesses was a complex task that required coordination of various activities and strategies in a dynamic environment. Considerable efforts across disciplines were needed to achieve sustainability of socio-ecological systems. In the process of reconstructing ecotourism and building sustainable livelihoods, the CFL played a critical role in forging links between the Adiri community and state and non-state entities across multiple levels (Fig. 2). As ecotourism gradually took shape, new problems emerged, including conflicts resulting from the distribution of responsibilities and resources among community members and thefts of natural and cultural property on the ancestral land by outsiders.

Cycle III: Restoring community solidarity and safeguarding the ancestral land

1. Observation and problem identification

Since most Adiri residents had been resettled after Typhoon Morakot, conflicts among community members on the ancestral land and those at the relocation site were also exacerbated by the influx of aid resources and an unequal distribution of responsibilities within the community in the post-disaster period. Additionally, Adiri's ancestral area suffered from the unregulated entry of visitors, thefts of cultural artifacts, and illegal logging and hunting by outsiders. It was necessary to develop strategies to respond to radical changes in Adiri's relationship with their ancestral lands and conflicts among community members.

2. Planning and implementing action

To resolve conflicts and misunderstandings associated with the distribution of responsibilities and resources between Adiri's ancestral land and the relocation site, periodic community reconstruction meetings were

held, with the CFL serving as a facilitator and coordinator. An Adiri reconstruction working group was also established during this time as a platform for facilitating communication and collaboration among community members. It helped restore social cohesion and norms of reciprocity that contributed to social sustainability of Adiri.

Several important decisions were made through discussions by the Adiri reconstruction working group, including a decision to repair the Adiri's Sasadra ancient trail and renovate the old village office into a tourist information center. The Adiri reconstruction working group also recruited community members at the relocation site to form a patrol team that would voluntarily safeguard their ancestral area against theft and damage, thereby protecting their environmental and cultural heritage.

To reunite the gradually disintegrating community, emphasizing their cultural traditions and practices became a strategy for enhancing social bonds within the community. Due to the Chief's continued efforts, the Adiri community choir was established to practice traditional songs and performed in public. Regular choir practice provided great opportunities for community members to meet and socialize. Adiri residents also used their traditional songs and music to tap into their collective memories and attachments to their ancestral land.

Adiri residents actively worked with governmental agencies to safeguard their cultural and natural resources. For example, to prevent illegal hunting, Adiri residents sought to work with the CFL and government forestry agencies to erect a sign that prohibited hunting in that area based on Taiwan's *Wildlife Conservation Act*. To regulate visitor entry, the Adiri Community Association and Village Office also made a request to the local government to erect a sign prohibiting visi-

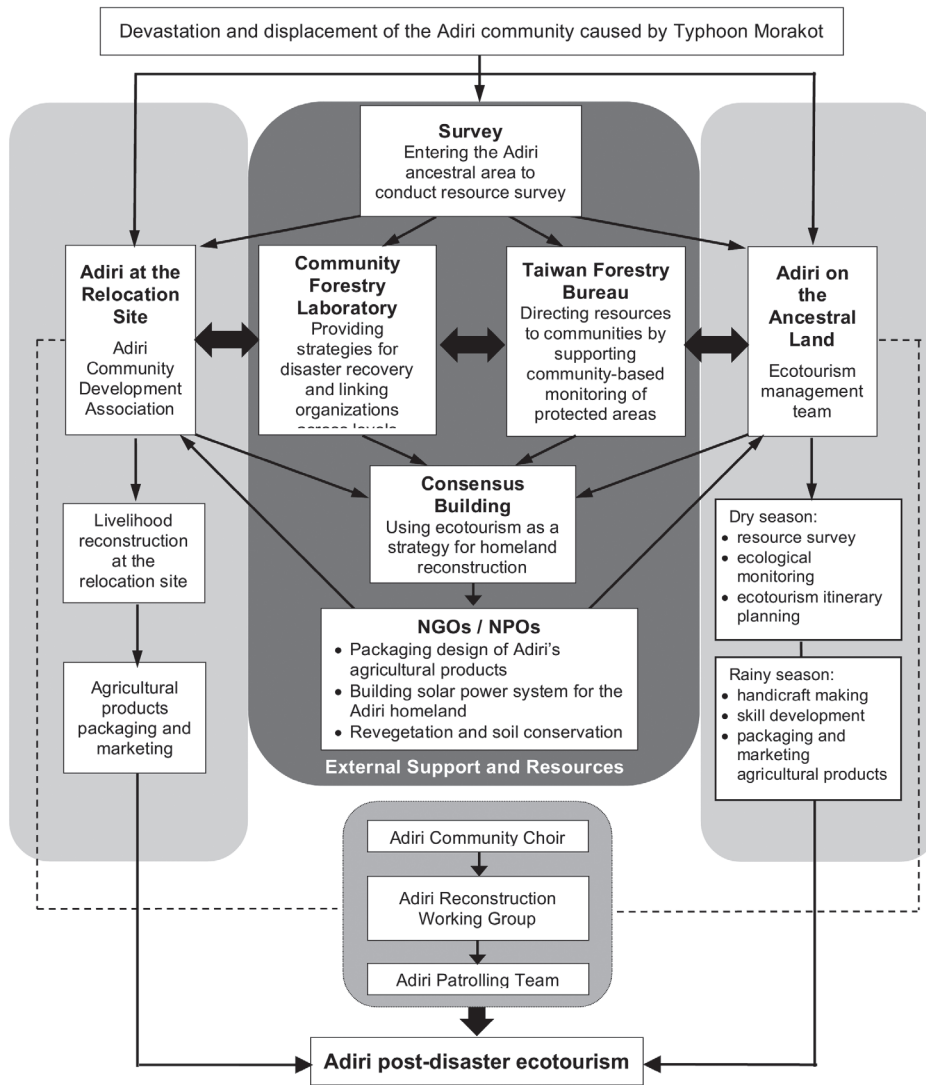


Fig. 2. Stakeholder relationships and responsibilities in post-disaster Adiri ecotourism.

tors from entering the Adiri’s ancestral land without permission.

3. Reflection

Establishing the Adiri reconstruction working group, patrol team, and community choir was a strategy to resolve conflicts that involved some misunderstandings regarding the distribution of aid resources and responsibilities. These community activities helped bring people together to collectively address

problems and concerns to achieve greater equality and a better understanding of community contexts (Fig. 2). The CFL played a mediating role in facilitating communication within the community, providing moral support, and helping the community gain other governmental and nongovernmental assistance required for community actions.

However, the theft of natural and cultural property committed by outsiders remained a threat to the community members. The erec-

tion of prohibition signs did not effectively stop uninvited intrusions. The voluntary community patrol team was discontinued as most community members were preoccupied by work at the relocation site. These problems eventually led to another cycle of planning and action for safeguarding the Adiri ancestral land.

After much discussion among Adiri residents, the CFL, and relevant government agencies, 5 indigenous communities in Wutai Township, including Adiri, Labuwan, Kabalelathane, Vudai, and Kucapungane, reached a consensus in July 2016 on the need to demarcate their ancestral lands as “Natural, Cultural, and Ecological Scenic Areas (NC-ESA)” in accordance with the law of the Taiwan Tourism Bureau. So far, this law is the only legal tool in Taiwan to regulate the entry of outsiders and restricting visitors to those accompanied by local certified guides. It is believed that these indigenous communities can ensure the protection of their cultural and natural resources as well as secure local employment opportunities by designating their ancestral lands as NCESA. In this regard, the political and administrative support provided by the government at all levels has been and will continue to be critical to future actions for sustainability.

DISCUSSION

Adaptive management of socio-ecological systems is an ongoing process of collaborative learning, trust building, and problem solving. This study presents an empirical case of how the Adiri community dealt with abrupt changes and uncertainties through multi-level collaboration during the 2 years after Typhoon Morakot. By taking a PAR approach, the CFL worked with Adiri community members to develop strategies for post-disaster recovery

and sustainable development.

This study found that sustainability can be a boundary object to initiate intercultural communication and collaboration between a community, university partners, and environmental governance authorities. In the project of community participation in post-disaster ecological monitoring, the TFB’s concept of sustainability focused on maintaining and protecting biodiversity as a common good while the Adiri community’s concept of sustainability stressed a deeper, culturally based understanding of relationships between humans and the land. Although the concept of sustainability was defined differently, it allowed stakeholders to collaborate on a common task. However, using sustainability to build bridges among stakeholders does not guarantee trust building. Matching ideas and words with actions is crucial for building and maintaining trust (Christopher et al. 2008). PAR can serve as a bridge between theory and practice, words and actions. Moreover, trust among various partners is often established and maintained when actions are taken and tangible results are produced.

This study shows that the principles of PAR align well with the spirit of adaptive management. The continuous cycles of PAR, including problem identification, planning, action, and reflection, are processes of learning-by-doing that integrated Adiri community members’ perspectives and inputs as well as support from governmental and nongovernmental agencies. As a bridging organization, the CFL played an important role in bringing in different groups in networks and creating opportunities for new interactions that were critical to dealing with uncertainty and change. The new ideas and connections brought by the CFL during the PAR process helped Adiri residents gain access to non-local resources and assistance needed to

implement actions. PAR thus bridged academic research and practical actions not only through connections between researchers and the community but also through researchers' social networks composed of key actors and links to a diverse web of resources.

In addition, the findings of this study suggest that community values and actions served as a guiding force in the collaborative learning processes. From the beginning, the use of ecological monitoring and ecotourism as strategies for post-disaster recovery was driven by Adiri residents' desire to revive their culture and livelihood attached to their ancestral land. When new problems emerged, such as conflicts within the community and intrusion of uninvited tourists, Adiri residents, the CFL, and other partners co-developed new strategies to address the issues and problems. Yet, the trajectory of Adiri's development was primarily shaped by the willingness of and actions undertaken by community members.

The collaborative partnership discussed in this article took considerable time and efforts to build. Implementing the PAR process in other communities will have unique contextual challenges. This study demonstrates that building and maintaining relationships in the setting of managing socio-ecological systems are never-ending processes. The continued collaboration between Adiri residents, the CFL, and government agencies still encounters barriers that need to be overcome, including how to continually create opportunities for community members to make a living on their homeland in a sustainable way, and how to reduce legal and administrative barriers to co-management of natural resources.

CONCLUSIONS

This study provides an empirical case to demonstrate how sustainability can be used

to build bridges among various stakeholders and how PAR can bridge academic research and practical actions for dealing with abrupt changes and uncertainties inherent in socio-ecological systems. Although the concept of sustainability may be defined differently, it can still link stakeholders together to collaborate on a common task. One of the vital features of PAR is the equal partnership between researchers and community members. Researchers can provide bridging functions that help communities gain access to non-local institutions, technologies, and resources. More importantly, the perspectives and inputs of the Adiri community were not only integrated into all stages of PAR but also served as the guiding force in the process. The continuing cycles of observation, planning, acting, and reflection were also a process of building trust and capacity for all partners involved to adapt and respond to changing socio-ecological systems.

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