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Indigenous Knowledge and Endogenous Actions for Building Tribal Resilience after Typhoon Soudelor in Northern Taiwan

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Abstract: Indigenous peoples often face significant vulnerabilities to climate risks, yet the capacity of a social-ecological system (SES) to resilience is abstracted from indigenous and local knowledge. This research explored how the Tayal people in the Wulai tribes located in typhoon disaster areas along Nanshi River used indigenous knowledge as tribal resilience. It applied empirical analysis from secondary data on disaster relief and in-depth interviews, demonstrating how indigenous people's endogenous actions helped during post-disaster reconstructing. With the intertwined concepts of indigenous knowledge, SESs, and tribes' cooperation, the result presented the endogenous actions for tribal resilience. In addition, indigenous knowledge is instigated by the Qutux Niqan of mutual assistance and symbiosis among the Wulai tribes, and there is a need to build joint cooperation through local residence, indigenous people living outside of their tribes, and religious or social groups. The findings of tribal resilience after a typhoon disaster of co-production in the Wulai, Lahaw, and Fushan tribes include the importance of historical context, how indigenous people turn to their local knowledge rather than just only participating in disaster relief, and how they produce indigenous tourism for indigenous knowledge inheritance. The paper contributes to contemporary tribal resilience research as well as cooperation actions among tribes through indigenous knowledge, all of which exhibit social, nature, and economy resilience from their own indigenous knowledge to address the possibility of governance and disaster adaptation.

Keywords: resilience; social-ecological system; indigenous knowledge; Tayal people in Taiwan

Citation: Lee, S.-H.; Chen, Y.-J. Indigenous Knowledge and Endogenous Actions for Building Tribal Resilience after Typhoon Soudelor in Northern Taiwan. *Sustainability* **2021**, *13*, 506. https://doi.org/10.3390/su13020506

Received: 1 December 2020
Accepted: 30 December 2020
Published: 7 January 2021

1. Introduction

Most indigenous people living in geographically high-risk areas suffer vulnerabilities to the risks of climate change [1]. Rainfall patterns have suddenly changed, while the climate change has increased the frequency and scale of rainfall-induced landslides. A typhoon is one of Taiwan's most hazardous disasters in Taiwan and causes considerable loss of life and property [2–6]. Its extremely torrential rainfall causes floods, landslides, and mudslides in indigenous tribes' regions, especially economically over-developed areas. After disasters occur, people adopt the thinking of recuperation and land conservation, yet the capacity of a social-ecological system (SES) to resilience is derived from indigenous knowledge, which is increasingly gaining international attention as a way to combat climate change [1]. By focusing on indigenous and local knowledge, one can broaden the level of knowledge existing within tribes that are impacted by environmental hazards.

Climate events contribute to the occurrence of disasters, and the combination of environmental hazard and vulnerability exposes indigenous tribes to potentially dangerous settings [7]. UNESCO (United Nations Educational, Scientific and Cultural Organization) [8] has acknowledged the importance of indigenous knowledge, and land resource management practices should engage traditional wisdom from them. One may disengage from environmental hazards by recognizing, and promoting traditional knowledge (TK)

coping mechanisms, which can also build the capacity of recovering relief in an indigenous area [9]. This paper emphasizes on indigenous knowledge and proposes its important significance at affording the practice of SES for providing disaster relief. In August 2015, Typhoon Soudelor dropped total accumulated rainfall of nearly 800 mm and caused over 100 landslide collapses in the Wulai area of northern Taiwan. Espeso-Molinero and Pastor-Alfonso argued that "each socio-ecosystem will have its own ways of developing resilience and so a specific in-depth study of each case is required" [10] (p. 657). The aim of this study is to explore the processes, the resilience after typhoon disaster, and interaction during post-disaster reconstruction through indigenous knowledge (IK) of the Wulai tribes in Northern Taiwan.

According to the Indigenous Peoples Basic Law [11], a tribe refers to a group of indigenous persons who form a community by living together in specific areas of the indigenous peoples' regions and follow traditional norms with the approval of the central indigenous authority. The Tayal tribes are small-scale communities based on mutualism in Taiwan. The social actions during disaster relief initiated within the Wulai tribes (endogenous) are automatically instigated by themselves, instead of outsiders or local government (exogenous). Endogenous actions based on the Tayal gaga (social regulations and cultures) and Qutux Niqan (sharing groups) of IK make up their traditional culture. The Wulai tribes launched the Qutux Niqan to maintain people's lives, tribal social functions, and more importantly tribal cooperation, food resilience, social resilience, and indigenous tourism preparedness under the Tayal gaga for resilience. There are also interconnections between IK and other aspects, including environmental management, social values, and beliefs. IK is dynamic and adapted in a disaster from indigenous holistic worldviews.

To explore tribal resilience-building actions, this research used in-depth interviews from post-disaster reconstructing cases in three tribes (Wulai, Lahaw, and Fushan), populated along Nanshi River, in response to natural hazards and endogenous actions by the indigenous peoples. We illustrate the impacts of Social-Ecological Systems (SESs) on endogenous actions of IK after a typhoon in the Wulai area. The research problematic issues are as follows. (1) How did the Tayal people initiate co-operative endogenous actions under indigenous knowledge? (2) What is the social resilience in post-disaster reconstruction? (3) What is the food resilience in post-disaster reconstruction? (4) What economic recovery actions were adapted after disaster? To answer these questions, this paper categorizes these actions during the post-disaster into a broader level of endogenous (launched from within the tribes) actions of Tayal IK in the Wulai tribes where they subsist, develop, and build inter-ethnic relations based on the nature and environment.

2. IK, SESs, and Tribal Resilience

Environmental and anthropogenic factors affect indigenous societies through increasing disaster risks [12,13]. Resilience is "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feed backs" [14] (p. 4). The most important mission is to develop sound social and cultural values with the traditional way of life in order to realize community development toward more sustainability and less waste in the contemporary world [12].

Many researchers have assessed those communities or tribes that have embraced indigenous knowledge have managed to save lives and property, and utilized disaster risks analysis to complement and expand scientific knowledge on reducing vulnerability [15–19]. In many discussions about the indigenous knowledge system, concepts and definitions are often used interchangeably, such as indigenous knowledge (IK), traditional knowledge (TK), local knowledge (LK), and traditional ecological knowledge (TEK). Indigenous knowledge is the unique knowledge confined to a particular culture or society that has evolved all the time [20–25]. It is not just a kind of knowledge, but also the practical experience and skills of indigenous life. In the 1960s, there was an "Anti-Mainstream" movement in Western developed research on "Oriental," "original," and "local" cultural knowledge [21]. Thus, this kind of knowledge is available and working in local tribes. IK is often regarded as

static, simple, and primitive [22,23]. While in many instances the term TEK is used, "IK is broader than ecological knowledge and better reflects the holistic worldviews that often underpin IK systems" [24,26]. Indigenous spirituality, man-land relationship, and the managing of resources are included in IK and presented in tribal members' regulations and cultures. In many cases, exploiting IK can mitigate and reduce disaster risks. We therefore use the term IK in discussing the related research, except when citing literature that specifically uses other terms.

Resilience in ecology was first applied to the ability of a stable state to return to its usual environmental standard after degradation and overdevelopment [27]. When used in tribes, it can be the reconstruction paradigms of responses to disaster damage and vulnerability. The Tayal people are able to deal with hazards through the gaga (work together, sharing together) of IK. Resilience concerns environmental, economic, and social dimensions [28] that are relevant to IK and closely interact in social systems and the ecosystem [29] in a tribal society. Therefore, reconstruction actions should be established that are based on the concerns of IK and organized according to their needs and resilience within a tribe.

By reviewing much of the recent papers on IK, the useful cultural knowledge and social knowledge have been seen by many as an alternative way of providing disaster relief, reconstructing, and reducing disaster risks. Rapid environmental changes and potential environmental disasters have been caused by the development of foreign colonization and capitalization in the Wulai area. Howitt [30] proposed to consider more about the resilience, vulnerability, and adaptation of tribes' geopolitics under climate change and indigenous historical colonization. Building a resilient society requires a dynamic process in SESs thought [31–34]. Thus, tribal resilience needs to build upon the environmental, economic, and social aspects, which are the core concepts of social-ecological systems (SESs).

The development and strategic improvement in the ecological environment indeed reinforce the ability to adapt to environmental changes through the diversity of the participants in reorganizing [35–38]. The less resilient the system is, the lower is the capacity to sustain humans' well-being in the face of complexity and change. Olsson et al. [39] argue that adaptability among actors is needed to reinforce and sustain the desired social-ecological state and to make it resilient to future change and unpredictable events. Moreover, Olsson et al. [39] found adaptive governance is the approach to rising community self-management abilities and endogenous development on an economy. These can be done by important leaders who organize and transit in the processes [40].

SESs are inherently complex, but no one theoretical perspective is sufficient to analyze all feasible situations. McGinnis and Ostrom (2014) proposed a revised "social-ecosystem framework" that has gradually been spread internationally for empirical research applications [41–45]. Research pointed out that the local knowledge of SESs generated from local cultural and historical experiences has an important ability to adapt to the impact of disasters or climate change [46–48]. However, some scholars questioned SESs. For example, Colding and Barthel [49] reviewed the SESs literature spanning two decades and pointed out that many papers had an unclear definition of SESs and concept of "society." Therefore, researchers have also focused on what and how the Tayal society exhibit cooperation and social resilience during disaster relief.

3. Research Method

3.1. Research Area

The research site has been struck by many typhoons and is a part of the Wulai indigenous tribes in northern Taiwan. The Wulai District of New Taipei City is an indigenous tourism scenic attraction and very near Taipei City, the metropolitan capital of Taiwan. In 2016, it had a population of 6187, covering 321 square kilometers. There are four tribes here and it is one of the earliest indigenous townships that Taiwan developed for tourism since the 1950s. The geographical landscape terrain features of Wulai are such as canyons, river valleys, cliffs, waterfalls, mountains, and rivers. Indigenous people comprise the main

population, although more Han people presently inhabit this area. Hot springs, cable cars, forests, cherry blossoms, rhododendrons, ferns, Tayal culture, and a miniature train are tourist resources. The richly natural and cultural environment makes Wulai a famous place for sightseeing and leisure [50].

The use of hot springs (only for police and faculty) in the Wulai area can be traced back to the period when Japan governed Taiwan around the end of the 19th century [51]. After Japan withdrew following World War II, more and more households used water pumps to extract hot spring water. During that period, areas near the train station were filled with souvenir shops and hawkers taking photos for tourists, packing the area with people. Ever since the gondola opened in the Wulai area in 1967, tourists have been taking the train to Wulai to see the waterfall, and tourism business activities have flourished. With the popularity of mass tourism in the 1980s, waterfall viewing and the gondola tours brought a lot of tourists from Taipei's metropolitan area [52].

In the late 20th century, as citizens of the capital invaded the mountain area, the Tayal people were forced to leave their hometown. Riyueguang and Julong Mountain Villa introduced hot spring water to Chungchi, 2 km away from the river, and the Ogawa Yuen hotel on Wulai Street (Wulai tribe) introduced Japanese professional hot spring equipment. In the 1990s, the government began promoting hot spring tourism and building infrastructure and facilities in the Wulai area, which showed that government promotion of tourism policies encouraged Wulai to use its hot spring resources to increase tourism income, which achieved a solution for regional development. The hot spring hotel industry brought the economies of Wulai and Chungchi more closely integrated with the tourism industry. Tourism activities that already were the livelihood of the local people also brought forth many tourism impacts. A lot of luxury hot spring hotels flourished in the Wulai area in the 2000s.

In Wulai District, the Wulai, Lahaw, and Fushan tribes are located in the upstream, midstream, and downstream of Nanshi River, as shown in Figure 1. The Wulai tribe is the closest to downtown Taipei City in the Nanshi River basin, which has led to compressed space and rapid tourism industry flows. The capitalism and crowds of people from urban areas have all been influential in altering the original state of the Wulai tribe. With the advent of capitalism and consumption, the indigenous people have come to realize they must share their tribal space with tourists and display items that visitors like to see in order to earn money especially in the Wulai tribe. This conclusion resonates with what Edensor advocated that tourism is a process consisting of unseen behavioral patterns and actual space reconstruction. Embedded in the host-visitor context, this process has enhanced the influence of mainstream tourism on indigenous areas. This is deemed as a consumptive phenomenon of indigenous commodification; hence, the area is split into front-stage and back-stage spaces, as suggested by Goffman [53]. The front-stage space (Wulai tribe) is where the hosts (indigenous people) meet consumers; whereas the back-stage space (Lahaw and Fushan tribes) is the area where indigenous people live. In other words, the lent-out area is in the downstream part of the Nanshi River basin, which the tourists can easily approach via transportation, while the back-stage area is around the midstream and upstream of the Nanshi River basin where IK and cultures are better preserved.

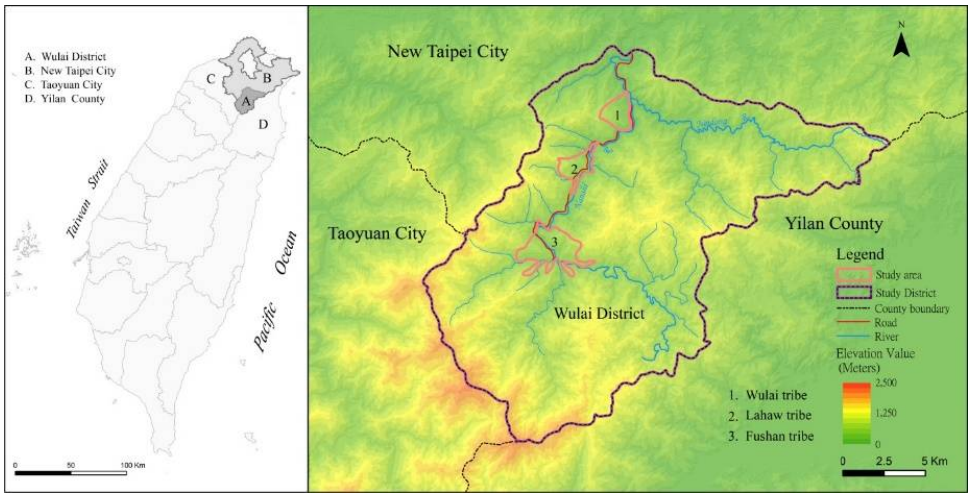

Figure 1. The location of Wulai, Lahaw, and Fushan tribes in New Taipei City.

3.2. Conceptual Framework

Secondary data collection was from a comprehensive review of literature using publications from scientific articles, papers, and reports after the tribes' areas were severely damaged, and contained findings from one year of observations in the three-year Ministry of Science and Technology project "Changes of Indigenous Livelihood, Place Bonding and the Social Space Model of Subjectivity (2014–2016)" [54]. According to the disaster prevention plan data [55], recent events in the area were mainly sloping disasters caused by Typhoon Sula in 2012 and Typhoon Soudelor in 2015, each of which had accumulated rainfall of 577 mm/day and 710 mm/day, respectively. The rivers in the Wulai area subsequently soared, moving higher than the embankments and bridges and causing many roads to be cut off. Although it is found that the distribution of landslides is approximately consistent with downhill in the Wulai area, indigenous tribes are generally impacted by environmental processes both non-anthropogenically and anthropogenically at all spatial scales.

During Typhoon Soudelor, the heavy rains in the Wulai area caused the Wusha River to soar and the streams and sands rushed over the bridge deck. The Dana Resort Farm located in the upper reaches of the Wushaxi Bridge was completely destroyed in this mudslide, and a total of 14 houses were impacted or buried by mud and rock. The rushing flow of water caused many collapses along the banks of the bridge, and mud and sand flooded into the hot springs hall and parking lot. Beside the waterfall park, a thick layer collapsed in the soil and rock interface, causing damage to a household that was almost buried. The collapse of earth and boulders caused traffic disruption to Huanshan Road. The lower slope of Route 9 collapsed, resulting in a 70-m roadbed gap. The collapse of the back slope of Wulai School caused the collapse of the school playground. Damages impacted the Wulai tribe (front-stage) and also disrupted roads to the Lahaw and Fushan tribes (back-stage). Given the severe damaged, 2000 Wulai residents were evacuated. About 1100 residents were reluctant to leave their homes, but the food shortage problem was affecting those trapped without any connection to the outside world.

Tribal resilience in providing disaster relief in a social ecological system after Typhoon Soudelor often has synergies with several elements of adaptive capacity operating at different scales. The Wulai tribes returned to their original self-sufficiency life when their water, electricity, roads, and communications were all interrupted due to the damage of landslides.

The above dimensions practiced within SESs for providing disaster relief in the interview context were identified into four significant general categories: cooperation, food resilience, social resilience, and indigenous tourism preparedness. For the Wulai tribes, SESs may make use of the disaster as a chance to transform into a more sustainable state. In

particular, IK continues to play a major part in the formation of many of these action sectors. By Tayal IK providing disaster relief, the indigenous people organized themselves with their traditional values and regulations and explored various paths in their reconstruction processes of environmental, social, and economic dimensions. These endogenous actions highlight the role of life sustaining (food), economy, and social resilience, and also show how IK reinforces the Wulai tribes' connectedness and collectiveness. It is this collective the gaga that the Tayal people draw upon to help cope with the social ecological system and offensive and defensive alliances that affect tribal society. They encompass the main strategy for which the Tayal people in the Nanshi River basin reduced disaster risks based on their traditional knowledge. The conceptual framework is shown in Figure 2.

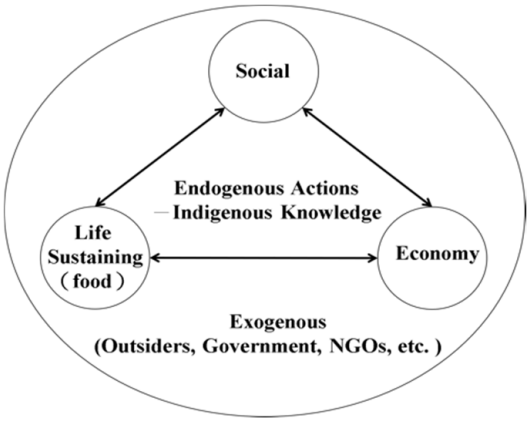

Figure 2. The endogenous reconstructing works in SESs for tribal resilience based on IK.

3.3. Data Collection

The methodological parts of this study were drawn from both primary and secondary sources. According to a comprehensive review after the tribes' areas were severely damaged, the disaster was caused during Typhoon Soudelor, which could be put into three categories that occurred to the Wulai tribes: collapse, mudslides, and flood [56]. The collapse area mainly happened to the Lahaw and Fushan tribes; the area of the flood was mainly located near the riverside of Nanshi River, as well as the area near the Wulai tribe and the main street (business street). The road linking the Wulai tribes to the main part of the transportation system was completely washed-out, dropping precipitously to the riverbed far below. Wulai suffered the most damage by the typhoon, with landslides cutting off the district's only road access to Taipei, as shown in Figure 3.

The project, Establishing Resilient Tribe for Climate Change: the Empowering Action Plan in Lahaw, Wulai, New Taipei City (2016.4–12) [57], of the Soil and Water Conservation Bureau showed that even though the typhoon damaged the areas of the original tribes seriously, the indigenous people stayed their own land tightly. Reconstructing their tribes in their own familiar and damaged hometown made them turn to take actions from the Tayal gaga of IK, especially for the disaster relief relationship between the different groups.

After the secondary data collection that helps present and analyze the reconstruction after disaster, we then process in-depth interviews obtaining qualitative information regarding the Tayal people who used IK and their endogenous actions and procedures. The key informant interviews took place in the Wulai, Lahaw, and Fushan tribes along Nanshi River. Interviews were guided by a series of open-ended questions about the disaster relief practice, involving environmental, social, and livelihood actions and the interaction under SESs. There were seven formal interviews, and in order to understand the long-term tribal resilience in SESs, we interviewed at least one time every year to the following interviewee individually from 2018 to 2019. Tribal elders, ward councilor (once), school teachers, and tourism industry staffs were the interview subjects. We use the triangulation approach to verify, corroborate, and enhance the credibility and trustworthiness or validity of the collected data.

Figure 3. The landslides cutting off the Wulai district's only road access to downtown. Photo: Taipei Times from EPA/New Taipei city fire department [58].

The primary method of a qualitative study is for researchers to employ in-depth interviews, allowing respondents to provide a narrative to present their subjective meanings and motivations [59]. Each interview lasted about 1–2 h. The text was then analyzed and compared and analyzed with secondary data in the Wulai area. The combination of secondary data collection and primary data from in-depth interviews focuses on examining the research questions in SESs for tribal resilience of what actions the indigenous people took for long-term rebuilding of their homeland after the disaster.

Based on secondary data collection, we conducted in-depth interviews from the following dimensions: (1) How did the Tayal people face the damaged environment and reconstruct their homeland after the disaster? (2) In the beginning, who called and led the disaster relief in the tribes? (3) From the shortage of food, water, and electricity supplied, how did the Tayal people maintain basic life necessities? (4) What are the livelihood and long-term economy of tribal resilience in the context of local knowledge after the disaster? Based on the endogenous-exogenous reconstructing framework, the interaction of IK between endogenous and exogenous actions in providing disaster relief of the investigation could be conceptualized in the following matrix (see Table 1). The endogenous and exogenous actions and sources are presented in terms of social resilience, life sustaining, and indigenous tourism preparedness. The arrow direction indicates the contents in the column were excited from another.

Table 1. The endogenous-exogenous and tribal resilience in the Wulai tribes.

Indigenous knowledge	Social Resilience	Nature Resilience (Life Sustaining/Food Resilience)	Economy Resilience (Indigenous Tourism Preparedness)
Endogenous actions and sources	Tayal gaga (social regulations and cultures): elders, hunting groups, young generation, Tayal women, etc.	1. Finding the source of river water 2. Preserve food in traditional style 3. Turn to hunting 4. The Qutux Niqan	1. Gathering together and inherit hunting culture 2. Sharing the hunting indigenous knowledge (IK) and culture with the tourists
Exogenous actions and sources	1. Tribes' churches 2. Organizations 3. Tribal people who live outside 4. Local authority	1. Tribal people who live outside carrying supplies and food back to their tribes on foot 2. Go through the local authority to connect with the Tayal people for transporting supplies back to the Wulai tribes	Go through the local authority and government to promote Wulai indigenous tourism

4. Results and Discussion

4.1. Cooperation under the Gaga: Indigenous Knowledge and Social Regulations

Indigenous peoples' land ethics toward the environment and natural resources as well as their traditional knowledge and competence such as ecological wisdom are based on their life experiences on food collection, fishing and hunting, and farming. The important characteristics of life cover the psychological demand of tribal people's interaction and sharing of collective work, work exchange, as well as food and information sharing with time and space arrangements of social life in order to maintain their material and social lives. The tribes are small-scale communities based on mutualism. They cultivate and hunt in the spacious mountain valleys and rivers. The mountain areas are their common properties and offer a form of man-land connection. Indigenous peoples' land development and management are based on their tribes with rights and public ownership of subjectivity. The villages possess land ownership, whereas individual are entitled to land use.

Endogenous actions from Tayal IK illustrate dynamic, cumulative, living social capital that could enhance the ability of the tribal society to cope with environmental change [60]. Tayal people have their own gaga (social regulations and cultures) with the functions of social control and mutualism (work and sharing together). The indigenous peoples have an intimate connection to the land. Different clans and ethnical groups share their cultures, languages, living models, and life development in the tribe, yet they attack together and defend against external invasion. During the seasons of cultivation, harvest, and hunting, they help each other and communalize into a solid tribal society (community with a common destiny). The tribes in the Wulai area combine different clans that cooperate with each other. Traditional Tayal social organizations are divided into clan, hunting, ancestral worship, sacrifice, mutual groups, and elders' meetings, with members of them often overlapping. The gaga of IK not only connect the Tayal people, but also are the keys for a modern indigenous society to reconstruct traditional values and spur endogenous actions for tribal resilience.

Indigenous peoples in Taiwan follow a traditional social organization based mainly on the clan system, especially the Tayal people who share resources and manage land by obeying the gaga of IK. The Qutux Niqan of IK was proposed from Tayal people. A member of the Fushan tribe said, "We called out to our relatives to deliver the food for the Wulai tribe (front-stage), and they carried what we needed during the disaster." Tribes' elders were also the chiefs of village. They were commanders who assigned various disaster relief affairs with their local knowledge. For example, because of the Tayal concept of hunting space, the elders and hunters have mastered the characteristics of the river basin and thus helped local people in how to walk along the river back to tribes, however, this is more difficult than usual without IK. "I have walked along the Nanshi River with the elders when I was a little boy. That is the collective memory of IK in my Fushan tribe (Respondent D)." Thus, Tayal people have a set of abilities in how to adapt themselves in the physical environment (e.g., finding the source of river water) and to gather and hunt successfully. In SES, IK provides the needed support or antecedent basis for the mechanism of long-term interaction with mountains and forests as well as inter-ethnic relations. That is why experienced hunters and elders are better equipped to organize different groups and collect food in the mountain, especially during a disaster.

During the food shortage transition period after the typhoon disaster, Tayal people used alternative nature routes for carrying supplies and food back to their tribes on foot. They walked along the Nanshi River basin and supplied the food from Xindian District of New Taipei City to the Wulai tribe and then transported it further to the Lahaw and Fushan tribes. Tayal people also responded to shortage conditions by adjusting their lives back to hunting, harvesting different species, and fishing with harpoons. "When we hunt after a typhoon disaster, the Tayal hunter taught us the rituals of the mountain and of ancestor worship, telling us the importance of revering, respecting, and thanking the mountains for our lives (Respondent F)." The indigenous people undertook social-ecological resilience to overcome seasonal variability and climate changes through processing the harvests and

using the resources provided within IK [61]. After the typhoon (Soudelor), Tayal people from different tribes gathered together and cooperated through the gaga belonging to IK. In this situation, IK is the cause of endogenous action whilst sharing groups (Qutux Niqan) and with other social organizations to strengthen the endogenous actions and form a set of strategies for sustainable use of natural resources [62] and disaster risk reduction benefit from the accumulation of IK.

4.2. Social Resilience

The elderly class is those who actually execute the Qutux Niqan of mutual assistance and symbiosis among the Wulai tribes. They can call for different groups to influence the internal social system as well as all attitudes and behaviors. Women's groups, youth organizations, hunters, and the elderly exert social resilience and endogenous actions during disasters. Through the Qutux Niqan, the tribes devised of labor. Women are responsible for the meals of the tribes, and some are responsible for food distribution, cooking, washing dishes, environmental organization, etc. As noted by Respondent B: "The Qutux Niqan is our traditional culture of IK, and we often share food with our relatives, friends, and tribal members in front of our house." Another important group is young people. During the period of providing disaster relief in Wulai, young people showed a lot of physical hard work in operating machines for rebuilding and removing soil and rocks that fell on the roads, whereas those who lived in the urban area set up supply teams to carry supplies back to the tribes on foot. Most important of all, the hunters who have IK were able to provide enough meat, fish, and other proteins by hunting to the local people (e.g., the hunter catch fish through the traditional method, as shown in Figure 4).

Figure 4. The hunter set up fish trap baskets in the stream to catch fish.

The Tayal people were also in contact with the tribes' churches and other social groups, requesting for supplies, such as the Presbyterian Church in Taiwan. The caring group was composed of pastors who visited the Lahaw and Fushan tribes in order to help meet their needs. Therefore, tribal social resilience was built in a joint cooperation through local people, indigenous people living elsewhere, and religious or social groups.

4.3. Food Resilience

The forest's resources are dependable and help the tribes live long and prosper. Fundamentally, indigenous peoples depend on forests for their livelihoods and food security [63]. Using drying, smoking, or salting meat of IK, the Tayal people preserve food carefully in case they cannot hunt during a natural disaster. The fish property rights of the river were decided under negotiation between the different tribal leaders based on traditional regulation. Under their agreement, they can achieve the goal of protecting fish ecosystems by fishing in different seasons and sections [64].

After the typhoon, the Tayal people salted the meat downtown and then carried it back to the Wulai tribes. Indigenous populations in the back-stage space (Lahaw and Fushan tribes) have a wide variety of ways to collect and preserve food. They also share

the storing and preserving of food with other residents during disaster relief. Nowadays, this knowledge of ensuring food availability during an environmental event is preserved in the back-stage space by the Tayal IK, even though modernization has encroached upon indigenous tribes. They also use water from mountain creeks through their local knowledge of the environment. Enhancing the ability of communities to mitigate disaster risks and coping when disasters strike do not increase dependency on external assistance, but rather help support tribes' self-sufficiency through endogenous measures [9].

4.4. Indigenous Tourism Preparedness

Indigenous knowledge inheritance from ancestors over the centuries helps current-day tribal members cope with environmental hazards and to face natural disasters. Governments increasingly recognize that the reduction of disaster risks forms the foundation for successful sustainable development. However, IK has only begun to be applied to environmental and social validation practices in the ecosystem for sustainable development in the late 20th and early 21st centuries [65–68].

The impacts of climate change on tourism destinations are mostly from damage to the physical environment in mountainous areas. After years of disasters, the Wulai indigenous people are aware of over-development due to economic growth. Moreover, as tourism has developed at an industrial scale and become profit-oriented, it has begun to exert a negative impact on indigenous peoples' traditional cultures and values and impeded the development of indigenous tribes. Today, the Tayal people's lifestyle has changed, as there is a gradual loss of their IK. General employment restricts them from practicing traditional skills, and formal education limits how they teach the next generation. They have thus begun to ask themselves how their traditional cultures and natural environment can be maintained.

The Wulai and Fushan tribes started to promote eco-cultural tourism, including a hunter school and learning about IK inheritance to help spread the Tayal traditional life and mountain-related culture and to identify with the Tayal's worldview and cultural spirit. Hunting culture and knowledge are the main subjects of indigenous life. The Tayal hunters' archery and hunting skills are inherited via hunting culture and IK. They realize that indigenously co-existing with mountains and forests is the most important value to develop tourism themselves after tourism industry over-developed and the disaster. In indigenous tourism contexts, the tribal socio-cultural fabric economy could enhance the resilience to cope with disasters and crises. The local people see indigenous tourism as a strategy to inherit and continue their IK. "I taught the hunting skills to the tribal members in order to perform them for the tourists. By doing these, the young generation have the motivation to learn hunting (Respondent C)" (as shown in Figure 5). Based on this ethnic consciousness, the Tayal people have spontaneously, actively, and collectively established organizations to operate a hunter school and IK inheritance groups that regard indigenous tribes as the subject instead of the object.

The Tayal people want to inherit and extend the spirit, value, and living system of IK and put it into practice in indigenous tourism. The hunters can encounter tourists and outsiders by the indigenous cultural courses offered, especially in the Fushan and Wulai tribes. They are aware of the limitations of family or the informal education of IK in tribes and thus take a relatively positive view toward such economic livelihood to cope with this situation. Economic recovery needs to link together humanitarian needs, environment restoration, and the rebuilding of new social networks and livelihoods [69], which must be drawn from the function and influence of resilience [70]. Hunters teach the indigenous and local knowledge and are attracting some young Tayal people to join them. Indigenous tourism concerning preparedness knowledge and skills is based on their IK and is constantly being updated with new approaches and information that meet the environment and climate challenges.

Figure 5. The hunter taught the young generation how to take bows and arrows.

5. Conclusion: Endogenous Actions in Tribal Resilience

This research presents the endogenous actions built up from inside an indigenous tribal society after Typhoon Soudelor and contributes to a deeper understanding of tribal resilience. In particular, we consider how three tribes in the Wulai area of northern Taiwan utilize IK in disaster relief efforts. For the social-ecosystem framework, the Tayal people undertook actions in disaster relief, used natural resources, and developed indigenous tourism preparedness, demonstrating their environmental, social, and food resilience. Tribal resilience reveals the importance of Tayal gaga and the cooperation among indigenous tribes in the Nanshi River basin. A reconstruction of the endogenous actions by the Wulai tribes shows how they met communal objectives. However, cooperation still exists with (exogenous) outsiders to ensure that IK forms an integrated approach to the river basin's social-economic strategy as a whole, including coordination with the tribes' churches and other social groups. Furthermore, the concept of tribal resilience has been explored in the roll-out of the Qutux Niqan of Tayal IK, which reveals the critical role of partnerships at all levels of Tayal elders, hunters, women, and other stakeholders.

IK in the social ecological system illustrates how endogenous actions can build resilience in the Wulai tribes, despite political, economic, and modern societal disturbances. This current study and other SES papers have underscored the importance of social and economic resilience in identifying the broad spectrum of local indigenous values. We find that endogenous social mobilization deriving from Tayal gaga (social regulations and cultures) is the key factor initiating communalization and also at the core of reconstructing. The social approach to build tribal resilience is highly dominated by the Tayal people, and IK is used to gather and work together, meaning it is an endogenous form that requires the cooperation of the tribes through the gaga. The collaboration between endogenous and exogenous actions works well due to recognition of IK in tribal society. The Tayal IK is acknowledged by the different values and identities of groups co-existing in the Nanshi River basin. For example, when assigning the work of carrying food back to the tribe or hunting, the elders taught young tribal members, churches, and other social groups what steps to take. The Tayal people and their partnerships mobilize resources from a variety of sources to function together and jointly cooperate in providing disaster relief. Co-working between outsiders and insiders can motivate and enhance indigenous people's inherent social resilience. This can subsequently help promote sustainable development and build an internal mechanism in their communities, while also better understanding the needs and priorities of external support.

Indigenous tourism preparedness is a planning process that is central to cultural and social themes that have emerged in SESs around local knowledge-specifically, how IK directly enriches indigenous tourism, and whether local efforts can contribute to minimizing

emerging risks. We offer some evidence that indigenous tourism supported through IK indeed works well [71–73], and that indigenous people in recent years also wish to raise the younger generations' understanding of Tayal IK through indigenous tourism preparedness.

Natural hazards have severely impacted indigenous areas in Taiwan. The reorganization phases of the endogenous actions demonstrate how tribal resilience has built up through IK. The findings of this study also emphasize the importance of social resilience and food resilience of the Qutux Niqan during supply shortages that occur following a disaster. By focusing on disaster relief of the Wulai tribes after Typhoon Soudelor, this research offers another approach for endogenous actions with a collective orientation toward following IK and experiencing the sharing together of resources with other tribes during reconstruction. In Taiwan, climate change hazards have brought forth the need to set up support social capital entry points, including the practice actions of IK (e.g., hunting, finding the source of river water collectively during a disaster, cooperation with neighboring members under gaga, sharing food, building a livelihood of IK after environmental change, etc.).

Future research can conduct more case studies to investigate how indigenous people use their IK to build resilience, because many valuable things can be learned from endogenous actions for reconstruction after a natural disaster. Tribal resilience can enhance current disaster relief knowledge and provide more guidance to local governments and social organizations such as NGOs and practitioners. Many studies and international climate change reports [74,75] have identified the importance of IK in reducing socio-economic vulnerabilities to disaster as well as how to deal with environmental and other hazards that trigger them. This research contributes to the growing body of IK literature at resilience to climate change. To strengthen resilience, indigenous tribes must prepare for and recover quickly from environmental hazards by sharing their cultural awareness and skills of IK through indigenous tourism. Specifically, analyzing endogenous actions in disaster relief via SESs allows one to verify and acknowledge the resilience, based upon enhanced IK engagement by indigenous peoples at disaster risk reduction. The end result can better leverage as well as help create more resilient tribes that are able to achieve disaster management and sustainable development.

Author Contributions: Conceptualization, S.-H.L. and Y.-J.C.; methodology, S.-H.L. and Y.-J.C.; validation, S.-H.L.; formal analysis, Y.-J.C.; investigation, S.-H.L. and Y.-J.C.; resources, S.-H.L.; data curation, Y.-J.C.; writing—original draft preparation, Y.-J.C.; writing—review and editing, S.-H.L. and Y.-J.C.; visualization, S.-H.L.; project administration, Y.-J.C.; funding acquisition, S.-H.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Ministry of Science and Technology grant number 103-2420-H-034-001-MY3 and 108-2410-H-003-110–SSS.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Social and Behavioral Research Ethical Principles and Regulations, and approved by Research Ethics Committee, National Taiwan Normal University (REC Number: 202011HS012 and 12 November 2020).

Informed Consent Statement: Informed consent was obtained from all interviewee involved in the study.

Data Availability Statement: Restrictions apply to the availability of these data. Data was obtained from Soil and Water Conservation Bureau, Council of Agriculture, Executive Yuan and are available online: https://246.swcb.gov.tw/Achievement/DisastersContent?EventID=465.

Conflicts of Interest: The authors declare no conflict of interest.

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