

Article

Collaborative Conservation of a Socio-Ecological Production Landscape through ICT Tools

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Abstract: Rural socio-ecological production landscape (SEPL) presents a mosaic combination of various use and spatial patterns. The rural SEPL claims conservation because it produces bundles of ecosystem services and well-being for people. However, due to the prevalent use of Information and Communication Technology (ICT) in recent years, we attempt to explore how the new ICT tool was employed to conserve the rural SEPL. This study targets four rural communities that the Balian River flows across in Sanzhi district, New Taipei city. These communities self-organized a river conservation patrol team and utilized LINE (an instant messaging software) group to manage the SEPL as well. We conducted mixed method research to collect their group conversation evidences including time, amount and content for basic quantitative analysis. Further, we adopted the qualitative in-depth interviews of key-informants to examine the characteristic of activities, the collaboration among communities and the benefits and issues during their action practices. The results show the ICT tools are indeed effective in assisting in social learning when conducting a cross-region of SEPL conservation activities.

Keywords: socio-ecological production landscape; Satoyama; ICT; conservative activity; community collaboration

1. Introduction

Discussions on relations among human, society and nature concerning biodiversity and ecosystem services have drastically increased in recent years, making Social-Ecological System (SES) draw incrementally more attention. The frame of SES is on the basis of biodiversity and ecosystem conservation, and it integrates the probable outcome value and profit in the ecosystem in order to utilize resources on a sustainable basis [1]. The so-called concept of socio-ecological production landscapes (SEPLs) is originated from Food and Agriculture Organization (FAO) of the United Nations. The concept of Globally Important Agricultural Heritage Systems (GIAHS) was proposed in 2002 with a view to preserve, in the process of social modernization, disappearing natural environments including traditional farming technology, landscape and, even more, agricultural village culture and facilitate sustainability utilization and management measures. The regions designated by GIAHS are generally called SEPLs [1,2].

SEPLs refer to landscapes with sustainable production systems indicating harmonious interaction between humans and nature. It forms a dynamic mosaic biological habitat and land use activities maintaining biodiversity and providing materials needed to pursue human well-beings. In Japan, SEPLs studies are mainly highlighted in the concept of Japan Satoyama Satoumi Assessment (JSSA) to

undergo SEPLs evaluations [1]. Since the Noto Peninsula at Ishikawa, Japan was designated as a SEPL by GIAHS in 2011, the assessments of rice paddy farming history and tradition, culture, rituals, tribe formed by industries of agriculture and forestry as well as mosaic landscapes composed of farmlands and artificial forests [1]. As for other countries, Suzuki attempts to assess Satoyama of Sabah State in Malaysia with Satoyama agricultural development tool and happiness index [3]; and Kaoru Ichikawa tries to assess SEPLs in Cambodia via approaches of structure, profit and changes [4].

Many important SEPLs need collaborative conservation performed by local government and civil organizations. In recent years, people have gradually understood the importance of conserving all types of natural resources of ecosystem services, and have raised the conservation activity of SEPLs in regions. Therefore, for SEPLs conservation method, besides the previous government-led and top-down administrations, many regions choose alternative measures by combining local strength in local communities and conducting bottom-up approaches under the condition of the government's limited resources. Taiwan launched the community development policy in 1994 advocating the comprehensive community development with bottom-up decisions in community, empowerment and human building which means community members change to form a civil society. The subsequent promotions include EcoLife by Environmental Protection Agency (EPA) [5] and rural regeneration policy by Soil and Water Conservation Bureau, Council of Agriculture [6], and in multiple prominent cases for example 3, Taiwanese communities that joined the International Partnership for the Satoyama Initiative (IPSI) [7] are highly connected to community-oriented natural resources management.

With such a trend, residents in the community play the roles of SEPL administrators, and residents' empowerment and knowledge capacity becomes the key to effective administration. Therefore, upon elevating knowledge learning and activity opportunities for community residents on SEPLs conservation, social learning is a crucial process. Mostert et al. [8] indicated that the social learning among the river basin administration members can increase understandings and regeneration of important issues or building trust relationships and developing new organizations, etc. Craps [9] indicated that content management and social participation are the two major parts in the social learning process of integration river basin administration, the former emphasizes true information management process, and the latter poses concerns on the process of social exchange.

However, as information technology development progresses, commonly used ICT media such as computer and smartphone blend in natural resources conservation activities and become an ICT model, namely the social learning propelled by ICT to conduct information exchange and discussions on SEPL conservation activities. According to Onitsuka and Hoshino [10], the ICT tool social network services (SNS) refers to rural community communication taken on the basis of social capital and social network theory as foundations with an expected outcome of fulfilling community vitalization or heightening social capital. In the meantime, ICT takes the critical role in actual promotion, and it can balance instantly discussed information from each type of key-informant, and it allows the collective learning approach. Such a method assists in inducing each key-informant's perspectives and actions and lets community members mutually understand in order to advance mutual relations [9,11], thus social learning effectiveness can be facilitated.

So, what is the social learning process upon which SEPL conservation activities in communities through ICT is built? How can conservation outcomes be fortified? Scarce studies can be found currently. This study aims to understand social learning process and condition used at ICT on SEPL conservation activities and furthermore aims to discuss the social learning effect through ICT dissemination process, including time, quantity and content of content management as well as actors' participation benefits and adversities in social participation.

2. Materials and Methods

Many studies focus on ICT as a new communication tool in the rural context [12–14]. Similarly, for people using portable internet devices, for example smartphones and tablet PCs, ICT is popular even in rural areas [15–17]. In Taiwan, internet availability, including broadband access, is constantly

expanding. The LINE, particularly, is one of the prevalent freeware apps for instant communications on electronic devices such as smartphones, tablet computers, and personal computers in Taiwan. Hence, considering LINE use among multiple actors, including rural leaders, for collaboration purposes and for solving common problems together about SEPL collaborative conservation is quite a new and important concept. In this sense, this study targets a special case that consists of four rural communities that the Balian River flows across in Sanzhi District to conduct research on SEPL conservation activities. Actors of these activities are mainly members of Balian River Conservation Watch (BRCW), and members have applied an ICT tool (LINE) for communication (Figures 1 and 2).

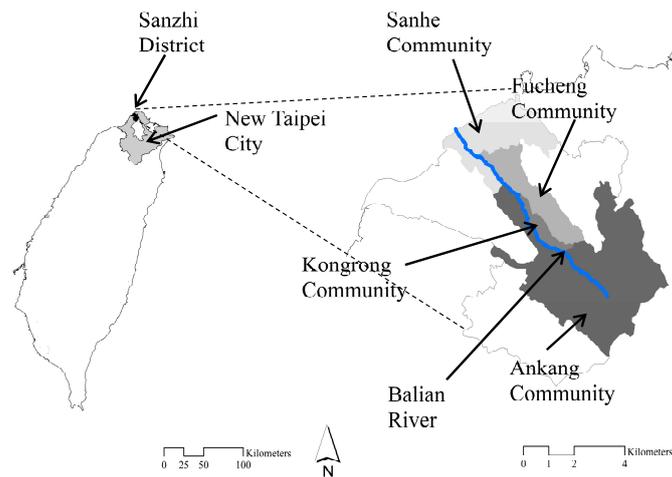


Figure 1. Location of the study area.



Figure 2. Site photos of surroundings of SEPLs. (a) The agriculture along upstream Balian River; (b) The downstream of the river; (c) The middle stream of the river; (d) Fishing activities prohibited along the river.

2.1. Context

The BRCW is proposed as a collaborative activity of SEPL conservation, because of the irrigation system drawing water from the Balian River. Most of the actors concern both agricultural water resources and SEPL conservation in the meantime. In other words, it is undivided between the quality of agricultural water resources and the outcome of SEPL conservation.

We attempted to understand the duration, method and content of the actors' uses to capture dynamic characteristic of SEPL conservation activities. Furthermore, qualitative in-depth interviews are introduced to understand the type of their social participation and to analyze the basic characteristics of the conservation content.

BRCW of Saizhi District, New Taipei City is an unpaid community volunteer group. Actors from the four rural communities started their collaboration and commenced discussions on River Closing and Fish Conservation back in 2006. Owing to over fishing and environmental conservation awareness, in 2007, after the announcement of by New Taipei City government, fishery activities such as angling and catching are prohibited throughout the entire river. In the same year, the BRCW assembled on the river case basis to devote themselves to SEPL conservation. Since 2014, they attempted to perform natural resources conservation activities with the help of the group feature of LINE. The scope of river Conservation starts from the water catchment area of Balian River at Datun Mountain in Sanzhi District, New Taipei City to the estuary with a total length of 11 kilometers and flowing area of 15 km².

The study sets the scope of research at the four rural communities that the Balian River flows across, and the communities were studied in order from upstream to downstream are Ankang Community, Kongrong Community, Fucheng Community and Sanhe Community, with the main research subject of key-informants in BRCW. The inner organization network in the BRCW currently consists of 34 people (Table 1). The patrol areas are deployed with teams according to scope of community; each team has a director and 7–9 community members. Scope of communities was not segmented based on administrative areas of villages but obvious rural landscape and objects were. Fucheng Community and Sanhe Community have experienced more development and have higher populations, households and urban planning area; however, the Ankang Community and Kongrong Community have lower populations and consist of all non-urban area.

Table 1. Basic contexts and BRCW members condition of communities.

Name	Ankang Community	Kongrong Community	Fucheng Community	Sanhe Community
Area (Hectare)	1520	210	603	754
Population (People)	1545	425	13,006	2140
Households	552	89	5071	820
Urban Planning Area Included	No	No	Yes	Yes
Number of people from each community for BRCW	9	9	7	9

To explain and explore a phenomenon regarding collaborative conservation activities based on the ICT tool, we conducted a mixed method [18]. The quantitative method basically explains the communication frequency and contents. The qualitative research basically tried to realize behaviors of the interviewees when using ICT tools while taking part in the SEPL conservation activities.

The study adopts chat contents of LINE as research information and performs content analysis. After consent of interviewee, captured samples of this study are from 19 July 2014 to 30 September 2014, and such contents are used for analyses of total use frequency, participation frequency, frequently discussed events and graphic assistance conservation activities. Changes of total use frequency are analyzed by the day and are analyzed periodical and frequency on the foundation of statistics of all LINE group members' messages during research; actor participation frequency analysis depends on message sending quantity of each actor during the period; frequently discussed events refer to analysis

of chat logs each day with over 50 messages; graphic assistance conservation activity is an analysis on photos and videos sent by actor in drawn group chat data.

For qualitative research, the study took field surveys and in-depth interviews during 8 March and 22 April 2015 with interviewees of BRCW and related actors (Table 2). The study investigated BRCW activity processes, contents and ICT using experiences via a semi-structured interview outline, and each interviewee received the interview for one to two hours.

Table 2. Qualitative interview interviewee information.

No.	Date	Location	Interview Unit	Position	Personnel Code
1	8 March	Fucheng Community Office	BRCW	Executive Secretary	F2
2	14 March	Self-Residence	BRCW	Director	F1
3	24 March	Sanzhi District Office	AEDS, Sanzhi District Office	Chief	DG3
4	21 March	Sanzhi District Office	AEDS, Sanzhi District Office	Officer	DG1
5	21 March	Fucheng Community Office	BRCW Kongrong Community	Leader	K1
6	21 March	Fucheng Community Office	BRCW Ankang Community	Leader	A2
7	30 March	Self-Residence	BRCW Fucheng Community	Leader	F7
8	20 April	Kongrong Community	BRCW	Staff	K10
9	22 April	Fucheng Community Office	BRCW Sanhe Community	Leader	S3

2.2. LINE Group Actors

The actor network inside the BRCW organization can be separated into four patrol areas in accordance with upstream-downstream relationship: Ankang Community, Kongrong Community, Fucheng Community and Sanhe Community. Most actors in the BRCW have joined LINE group, including director, executive secretary, patrol team leaders and members, with a total of 27 people. The 27 people contains 5 people from Ankang Community, 9 from Kongrong Community, 7 from Fucheng Community and 6 from Sanhe Community, and public-sector actors include 1 Chief and 2 staffs from Agriculture and Economic Development Section (AEDS), Sanzhi District Office, adding the aggregate to 30 people. The official book record contains records of 34 people whose information are kept by AEDS and the information is reported to Agriculture Bureau, New Taipei City, moreover, 1 staff with alias K10 is unregistered and doesn't join in Line group. LINE group actors are organized in Table 3.

Table 3. LINE group actor composition.

Ankang Community	Kongrong Community	Fucehng Community	Sanhe Community	Sanzhi District Office
A1	K1 (Leader)	F1 (Director)	S1	DG1 (Officer)
A2 (Leader)	K2	F2 (Executive Secretary)	S2	DG2 (Previous Officer)
A3	K3	F3	S3 (Leader)	DG3 (Officer of AEDS)
A4	K4	F4	S4	
A5	K5	F5	S5	
	K6	F6	S6	
	K7	F7 (Leader)		
	K8			
	K9			

2.3. Activity Content of Community Actor

The study organizes the work content through in-depth interview and LINE group conversation information analysis as such:

2.3.1. Patrol of Illegal Fish Catching at Stream

In accordance with Article 44 of The Fisheries Act, New Taipei City announced Balian River was Closing and the Fish Conservation section where angling and catching take place was now illegal. Patrol works are performed by the BRCW approved by New Taipei City Agriculture Bureau. If any illegal catching and angling is found at patrol, an exposure will be performed together with AEDS of Sanzhi District Office and Police, followed by staff of the division creating an event report for report to Agriculture Bureau of New Taipei City as a reference of penalty.

2.3.2. Water Potential Monitoring and Damage Inspection Works

BRCW inspects water potential, level surveillance and damage of Balian River before and after typhoon, then reports results to Sanzhi District Office, whose officers report to other related units for assistance of pre-damage preparation and post-damage rescue and patrol tasks.

2.3.3. Cleaning and Maintenance Tasks

BRCW performs routine stream cleaning and maintenance by assigning each team to clean their own section as well as supporting other teams on cleaning their sections.

2.3.4. Stream Project Construction Supervision Tasks

BRCW considers that related remediation of Balian River may deteriorate the neighborhood ecology; therefore, in the process of relative construction, all tasks will be photographed at site by BRCW members, along with supervision and understanding of construction status.

3. Results

3.1. Statistics and Descriptive Analysis of LINE group

3.1.1. Phase and Change of Total Use Frequency

This study introduces LINE group chats data from 17 July 2014 to 30 September 2015 for performing frequency change analysis, with a total of 4281 messages in Figure 3. If stickers, pictures and video messages are combined into one series of message, the number will be decreased to 3211. The BRCW introduced LINE to their routine tasks in 2014, and discussion frequency in the early phase (19 July to 31 December 2014) was rather low, with a maximum of 40 messages a day; during a couple of the days, no messages were sent. In the middle phase (1 January to 20 June 2015), the discussion frequency gradually soared, with a maximum of 70 messages sent a day, and days without messages decreased. In the later phase (21 June to 6 September 2015), discussion messages exceeded 80 messages a day, sometimes over 100, and days without messages became scarce. We can learn from such information that the LINE messenger use by BRCW has become more and more frequent through time, and members of the BRCW are now accustomed to using LINE as the tool of communication and discussion. We found that the chatting during a day all encircled few topics, so we highlighted and designated those events with more than 30 messages for further analysis and discussion.

3.1.2. Community Participation Frequency Analysis

Numbers of messages sent by the actors in the four communities are shown in Table 4, Ankang Community has 402 messages, Kongrong Community has 279 messages, Fucheng Community has 1423 messages, Sanhe Community has 556 messages, and Sanzhi Community has 551 messages. Messages from Fucheng Community are the highest among the participants, with 556 messages from Director F1 and 312 messages from Executive Secretary F2. Such facts reveals that these two community actors showcase leadership via LINE chats and discussions while the rest of the actors follow the instructions to perform patrol tasks.

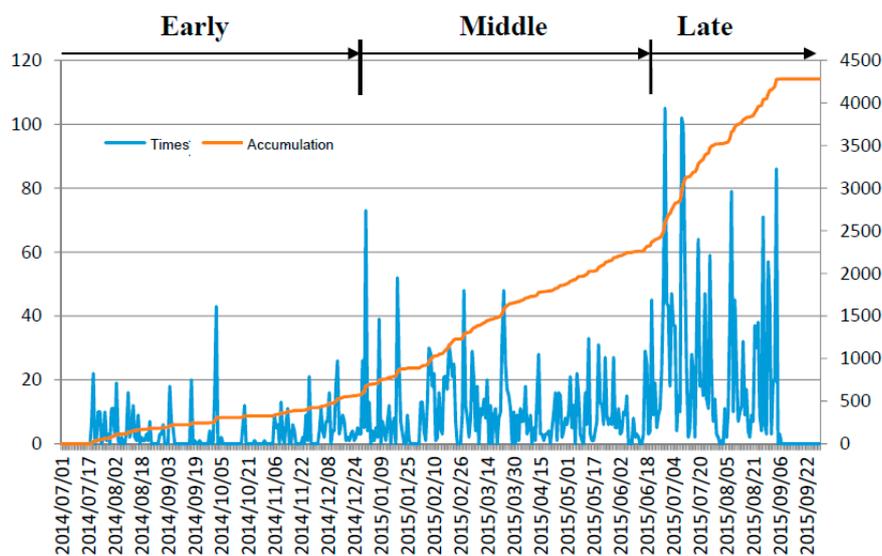


Figure 3. Total use frequency change by actors.

3.1.3. Participation Frequency by Individual Actors

After performing statistics on participation frequency by each actor (as shown in Table 4), the study has found out the following results, classified according to message frequencies: 0–20 times: community actors with passive participation. 20–100 times: community actors with slightly passive participation. 101–200 times: community actors with slightly active participation. Over 200 times: community actors with active participation. Among the community actors, the member with the most messages sent is the director F1, followed by the Officer of AEDS in Sanzhi District Office DG1, and the Executive Secretary F2 ranked 3rd, which indicates leadership roles in the community organization have a higher frequency when it comes to communications with government authorities. Thus, the key community actors' close collaboration with government staff plays an important role in rural tiling landscape conservation activities. The result manifests that the community contexts with higher population, households and included urban planning area seem to have more active participation than the communities with lower population, households and all non-urban planning area.

Table 4 shows the compiled results of the four participation situations. Most actors with more frequent messages sent come from Fucheng Community, the community with most active participation in discussions. Albeit the fact that Kongrong Community has more participants than others, more passive actors are found within. For Ankang Community and Sanhe Community, the participation situation comes in an average tendency. The director F1 and the executive secretary F2 are the most active participants, and team leaders from each community are actors with active discussion participation. Moreover, two previous officers (DG1, DG2) from the District Office are active actors, while the Chief (DG3) appears to be the one with slightly passive participation, indicating that contact windows of the BRCW and District Office are the staffs of the basic level staffs, with chiefs as the participants of subsequent decisions. The analysis highlights the chatting at an individual level and shows the importance of active role of the leaders. However, the limitation of inferring the meaning of messages makes it difficult to explain the difference among actors and even among communities, unless a questionnaire survey was applied to ensure the real meanings in the future.

Table 4. The condition of discussion condition by actors from each community.

Participation Condition	Ankang Community	Kongrong Community	Fucheng Community	Sanhe Community	Sanzhi District Office
Active			F1 (560)	S1 (231)	DG1 (319)
			F2 (317)		DG2 (202)
			F3 (215)		
Slightly Active	A1 (147)	K1 (114)	F4 (162)	S2 (155)	
	A2 (118)			S3 (106)	
Slightly Passive	A3 (95)	K2 (76)	F5 (78)	S4 (50)	DG3 (29)
	A4(34)	K3 (33)	F6 (41)		
			F7 (33)		
Passive	A5 (8)	K4 (18)		S5 (10)	
		K5 (15)			
		K6 (14)			
		K7 (10)			
		K8 (9)			
		K9 (8)			
Total	402	279	1423	556	551

3.1.4. Events with Higher Discussion Frequencies

This study calculates LINE group conversation data by day, for sampling days with over 30 messages, with 21 days in total (as shown in Table 5). The event on 4 September 2015 has the most (74 messages) discussions. The event discussion involves the director and the executive secretary's alleged resignation for their inability to stop the project affecting river ecology and the members' massive efforts to plead for the leadership roles' retentions. The event discussion ranking 2nd (64 messages) are the events on 10 July and 27 August involving patrol tasks for typhoon damage inspection by the BRCW and reports on stream potential before and after typhoon and loss after typhoon. As for generic events, these events include: illegal fish catching and angling, stream patrol report, advice to civilians, etc. Special events include: Discussions on river project protest, Stream water potential and damage patrols at typhoon, leadership role resignation discussions, etc.

Table 5. Chronicle of activities and events.

Date	Messages (Sum of Pictures or Videos)	Actor	Abstract of Event Content
4 September 2015	74 (5)	12	Executive Secretary and Director initiate willingness to resign due to their incapability to hamper the project, and team members encourages them along with dissuasion from resignation.
10 July 2015	64 (14)	17	Stream water potential report at typhoon
27 August 2015	64 (7)	11	Loss inspection after typhoon (road signs), stream condition patrol report, inquiry to district office on project contractors performing constructions near Balian River.
8 August 2015	56 (8)	9	Cancellation of patrol activity due to excessive wind and rainfall, and cautions
29 June 2015	53 (16)	12	Demonstration activity pictures on Day 2, illegal catching and angling event report
19 July 2015	53 (4)	9	Illegal catching and angling, report on civilians catching and angling event report to Police-Civilian Disputes

Table 5. Cont.

Date	Messages (Sum of Pictures or Videos)	Actor	Abstract of Event Content
30 August 2015	53 (4)	9	Members of the BRCW march to District Office for protest based on their grudge over Water Resource Agency district office on project contractors. The protest is ended by promises of suspension, followed by info-meeting on project commencement, by staffs of Agriculture Bureau.
9 July 2015	51 (9)	14	Stream water potential report before striking of typhoon
28 June 2015	41 (7)	10	Demonstration activity pictures on Day 1, advice to civilians on fishing prohibition.
26 July 2015	40 (5)	12	Illegal catching and angling event report
30 June 2015	38 (4)	12	Discussions on illegal catching and angling event occurred on the previous day, advice to civilians on fishing prohibition.
19 January 2015	37 (6)	10	Illegal catching and angling event, discussions on projects beside the river.
11 July 2015	37 (3)	11	Stream water potential report after typhoon, discussions on the number of patrol at downstream area on its scarcity.
22 August 2015	37 (2)	10	Illegal catching and angling event report
24 August 2015	36 (0)	6	Inquiries to District Office on Balian River District Office on nt report.n, discussions on the number of patrol at downstream area on its scarcity
10 August 2015	35 (0)	11	Pictures of drastic increase of river level incurred by typhoon and damage patrol report
24 March 2015	34 (6)	13	Reports on new recruits, reports on heightened river level, meeting notice, discussions on possibilities of making flexible uses of Balian River small dam construction
21 June 2015	33 (4)	7	Director1verew recruits, reports on heightened river level Balian River, water resource ratio for Balian River and fields should be adjusted, opinions of water resource conservation performed by Water Resource Agency
23 July 2015	33 (9)	14	Stream condition patrol report
4 July 2015	32 (3)	9	Activity affairs communication, advice to civilians on fishing prohibition
20 May 2015	31 (2)	11	Reports on rainfall, flow and turbidity of river water at striking of front, report on staff change in District Office.

3.1.5. Time Characters Using ICT Tools

This research has analyzed actors' time characters using ICT tools based on message sending time of dialogues in LINE groups. The activity time is on either a daily or yearly basis, and the contents for analyzing are message comparisons between director, the chief leader and all the actors.

Analysis of Daily Interaction Time

Conducting statistical analysis of message sending time of director and all the actors, analyzing by hour and the analysis results are shown in Figure 4.

There are 3211 pieces of dialogue concerning river guarding patrol among all the actors, the daily time distribution ranges from about 7 a.m. to 10 p.m. The time intervals with frequent conversations are from 4 p.m. to 10 p.m., during which break time in daytime and night time are the most important periods for interactive discussions, especially from 8 p.m. to 10 p.m. suggesting that users typically discuss at lunch time, and before and after dinner.

In addition, we have conducted statistical analysis for message sending time of director F1, the discussion time distribution of 556 pieces of river guarding patrol is almost consistent with the daily time distribution graph of all the actors, indicating that the leaders have played important roles of facilitators when proceeding community construction and rural conservation activities.

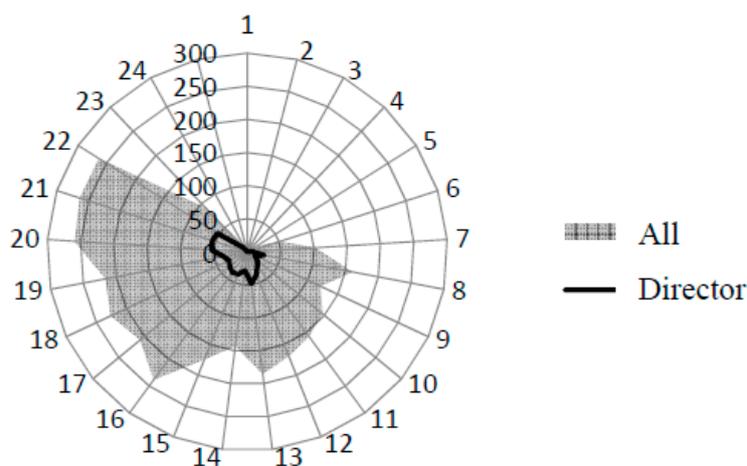


Figure 4. Daily message sending time frequency.

Analysis of Monthly Interaction Time

If analyzing by month, the statistical analysis figure of message sending time of all the actors and director is shown in Figure 5. The discussions regarding river guarding patrol prevail from June to August, and the popular issues are typhoon disasters, illegal fishing, visitor paddling activities and river construction. In view of the chats, we can presume that the illegal fishing by anglers and typhoon disasters are commonplace in summer, and in consequence, we can conclude that the application of ICT tools are conducive to patrol activities. This research has further compared the message distribution analysis of directors, which is almost consistent with that of all the actors. Therefore, we can see that it is common for leaders to lead other actors to discuss in LINE group.

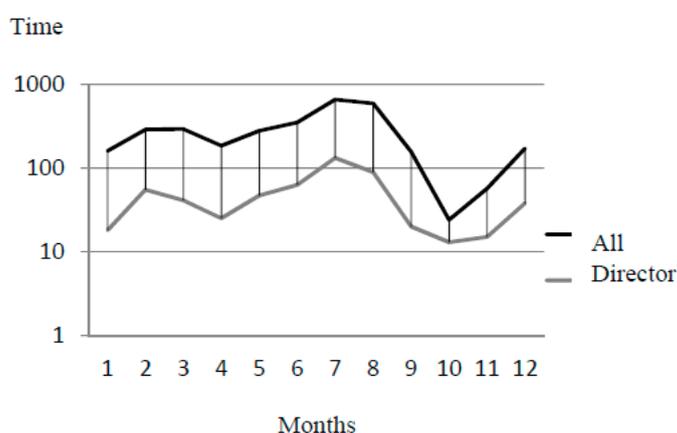


Figure 5. Monthly message sending time frequency.

3.2. Findings of Interviews

3.2.1. LINE is an Effective Tool for Providing Interactive Supports for Community Actors

According to interview contents, when patrolling, the members are working in pairs in An Kang Community, as for Kongjung, Fucheng and Sanho Communities, the members work alone to patrol Balian River. The team leaders in each community will confirm the daily patrol and control works of each member by means of mobile phone or home visits. However, when confronted with residents' illegal fishing and other violations, the rangers will inform other actors and implement collective action to handle the affairs for the sake of safety if disputes arise. This, however, is effort- and

time-consuming. In the BRCW meeting of 2014, the community actors proposed to take advantage of the group discussion function of LINE and make it an auxiliary helper for patrol work to promote discussion, given the prevalence of smart phones.

If there are illegal behaviors during patrol, you should ticket them. You may fail to do that yourself and you may find it inconvenient to call and contact others. You can use Line and everyone can see your message, and those who have time can just come and help. (K10)

In the beginning, the members of LINE consisted of only main cadres: the director, executive secretary, team leaders and several actors, and other members joined LINE later. The section members and section chief of AEDS in District Office also joined the LINE group and it has become a communication tool for BRCW and Sanchi District Office. The members believe that LINE group will exert positive effects when conducting patrol works.

3.2.2. Efficiency Improvements of Communication and Discussion among Patrols

The conventional BRCW discussions were only available at group meetings or on the phone or direct home visits and other one-to-one communicative methods, which have led to poor efficiency. However, with the application of LINE Group, the discussions are carried out using one-to-many mode, considerably increasing the opportunities to communicate with each other whenever and wherever possible. In addition, by the real-time interaction feature of LINE group, all the messages regarding contact information in peacetime, feedback on river patrol status, exposure of emergencies or illegal events, reports on river constructions, confirmations for river situations before and after typhoon, above which can all be responded and reported in an immediate manner to speed up the disposal and resolution of the crisis.

LINE is more efficient than Facebook which is limited by time. (K10)

It's equipped with real-time feature, we can be there as soon as possible if there are risks when we try to persuade others. At least we can get a sense of safety. (K10)

3.2.3. Assisting in Patrol with Image Transfer

Before applying LINE group, there were no images or videos but only written records. After the application of LINE group, the photos or videos of illegal fishing, exposure of illegal fishing gears, cages, river patrol conditions, river water flow before and after disaster, and early, middle or final stages of river constructions can all be delivered by LINE to serve as proof or video records.

We are all posting pictures as we are on duty. (K10)

The BRCW will take pictures on site to record the illegal fishing when exposing illegal fishing events and the events will be accessible to other members by LINE group as important proof of illegal fishing. In addition, the team members can compare the changes of river, such as comparisons of river construction at different stages or river water flow before and after disaster with the photos preserved.

3.2.4. Shortening the Gaps between BRCW and Public Sectors

Apart from patrol members, the staff and section chief of AEDS in District Office are also members of LINE group, LINE has now become the bridge between BRCW and public sectors. When confronted with illegal fishing, the BRCW can ask other members in LINE group for help, while also informing police to boast to the scene after the news is checked by staff in AEDS. Thanks to the real-time character and convenience of LINE group, BRCW can deliver the news to public sectors in an immediate manner to improve the response efficiency of risk handling.

The most important thing is, DG1 of AEDS in District Office is so earnest that he arrives at the scene when we call him on Line, which contributes greatly to the patrol duties. (K10)

In our opinion, we are ready to head to the scene upon receipt of his message and then conduct interview records with the alleged offender. The prepared interview record will be sent to Agricultural Bureau as a basis of whether to fine the offender. (DG1)

3.2.5. Barriers of Using LINE

At first, most of the actors in communities were not equipped with experience in using smart phones, which made the barriers inevitable, including actors being unskilled in operations, slow message texting speed and other problems. Generally speaking, actors would ask friends and family for help. The director-general and main cadres are responsible for supervising all the actors that join in the LINE group, and some actors changed their phones into smartphones and started to learn LINE group operations.

There were many barriers (when I started using phone and LINE), such as typing, photo sending and being afraid of pressing the wrong buttons or delivering the wrong meanings. (F7)

3.2.6. Impacts of Using LINE

The results of in-depth interviews generally show the impacts of using LINE for collaborative conservation of SEPLs, including: the increased trend of mobilizing to report the illegal fishing to the authorities although the real number of reports could hardly be obtained; the communications among communities associated with the relationships between upstream and downstream of the river have obviously increased and even expanded to their daily activities; due to the announcement of Balian River Closing and Fish Conservation associated with the BRCW activities, they observed that the biomass and biodiversity appeared increased however it needs to be proved by implementing some scientific biological investigation in the future; by the messages of LINE chatting exchanges and some actors reported that the cohesion among members has significantly promoted and there is no clear administrative boundary among communities as well; and the ICT tools surely provided instant communications and discussion fields to assist the message conveyable and recordable. These all coincided with the objective of collaborative conservation of SEPLs.

4. Discussions

According to previous research, ICT tools are the important bridges for internal or external communication and interactions of communities. The studies also point out that the Internet and SNS are helpful communication systems when it comes to the current development of communities in rural areas [19]. The network is conducive to facilitating the interactions among residents in rural areas and further forming regional network community [20]. In consequence, ICT tools cannot only shorten the gap among persons but also facilitate the cross-region (such as up and downstream communities) communication and promotion. Furthermore, the SNS can be a means of communication for community organizations and a way of providing supportive efforts in rural mosaic landscape conservation activities. Besides, just like other SNS tools, LINE and Facebook are effective in improving the social capital and network relations within and out of organizations.

From content management in social learning, the working contents of actors in SEPLs conservation activities carried out by communities including patrol against illegal fishing in river, water flow supervision and loss and damage inspecting work before and after typhoon, cleaning maintenance work and supervisions on river construction. According to the findings, the benefits from SEPL conservation activities by ICT tools including effective tool in interactive supports for community actors, efficiency improvement of member communication and discussion, assisting in patrol work by the application of image transfer and shortening the bridge between BRCW and public sectors. However, there are still problems and restrictions when using LINE, for example, LINE serves as an internal communication tool and some disclosed information or social public opinion should rely on Facebook for the purpose of reaching benefits from SEPLs conservation activities.

The chatting function of LINE is similar to an internal group broadcasting that is one-to-many sharing the same message simultaneously. In addition, the LINE group of BRCW was defined as a message delivered on the river case basis to devote themselves to SEPLs conservation so that it would function to promote an instant reaction to the events such as illegal fishing and disaster preventions. This function makes it difficult to identify the direction and connection of every single message from the outsider's viewpoint. For example, the leader F1 drove the discussions approximately 91 times of total 560 messages, the function of LINE limits the exact response directing to someone so that the number of responding would be less statistical meaning. So, a precise questionnaire survey to ensure the announcers and receivers will be necessary in future studies.

From the perspective of social participation of social learning, the frequency of ICT tools will increase as the elongation of activity time. And ICT tools are gradually developed into important tools for communication and discussion in SEPLs conservation activities, suggesting that the social participation has gradually been stable. And as for the changes in social participation frequency of individual sector, it can not only play a part in understanding the discussion situation but also make us find out that the leaders within our community organizations are frequent in contacting with governmental units, showing that the joint collaboration and relations between community actors and basic staff from governmental units as well as private sectors have definitely played important parts.

Compared with ordinary communication tools (such as telephone, letters and others), the considerable elongation of social participation duration of actors with ICT tools are beneficial for social learning. Furthermore, with ICT tools, we can understand ordinary members' daily discussion time duration, which ranges from 7 a.m. to 10 p.m. and the time with most frequent discussions are between 8 p.m. to 10 p.m. On a yearly basis, SEPLs conservation discussion are often focusing on June to August and summer is a season most likely to call together illegal anglers and suffer from natural disasters. In consequence, apart from reinforcing SEPLs conservation activities under effective application of LINE, ICT tools can also be references for future activity holding for community members.

The consistent application frequency and distribution scope of ICT between community leaders and all the members suggest that the leader serves as a social participation facilitator and this is important when conducting SEPL conservation activities. Also, the overall social participation will be promoted if the said facilitator is active enough. In this sense, transformational leadership must be based on facilitating communication or collaboration among a variety of external and internal actors. It manifests leaders' ability to network with a variety of actors inside and outside the community to ensure the collaborative progress. Transformational leadership thus circles around the concept of social capital which attracted scholars from a variety of academic disciplines, and numerous positive effects on society have been reported [21–23], yet some scholars found its negative impacts [24].

The concept of social capital is useful for understanding rural communities [25,26]. However, social capital is created through social networking in communities. Social capital studies often employ social network analysis to visualize and quantitatively measure social structure [27]. During the research, we have observed the differences in participation levels among community members. The concepts such as "building people", "empowerment" and "bottom-up" are important as the power of network structure are the key point of community research among members. Thus, it is recommended that the social network analysis can be applied to understand the relations of actors when carrying out SEPLs conservation activities and then measure power centrality.

5. Conclusions

This research has examined the LINE of ICT tools to confirm that these tools are indeed effective in assisting in social learning when conducting SEPL conservation activities. The results have ensured that the ICT tools can facilitate the cross-region communication and promotion among communities, help their community works and promote their community participations. The considerable elongation of social participation duration of actors with ICT tools are beneficial for social learning. This can be a reference for future activity holding for community members and mobilizing various cross-region

actors. It is also important that the leader acts as a facilitator in implementing ICT tools and mobilizing social participation. We recommend analyzing the social networks to understand the relations of actors and to better evaluate and verify the detail mechanism of empirical studies in the future. In addition, since using Facebook was recently so effective in Taiwan, it is possible to deal with the disputes when safeguarding the river by the information exposure feature of Facebook. Future studies would be worthy to examine the frequency with Facebook posts which were used before and after implementation of LINE, so as to reveal the effectiveness in the behavior of the district office and the Public Works Section.

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