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Management of the Upo Ramsar Wetland through the landscape components identified by residents

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Abstract: properly manage ecologically sensitive environments, especially where ecosystems and societies are hydrologically connected. However, keeping track of everyone's behaviour toward the environment within and around wetland protected areas can be challenging where one-dimensional regulation is applied to specific designated areas. Despite hydrological connections of wetland with the surrounding environment, only specific wetland or open-water areas designated for protection are strictly regulated. At the same time, residents of different villages are exposed to different quality and quantity of ecosystem services depending on the location of their residences. This study observed how local residents of the Upo Wetland (Ramsar, a national wetland protected area of Korea) community perceived and identified fundamental landscape components differently depending on the residence location where water flows in, through and out of the wetland protected area. A semi-structured interview was conducted for each participant to understand the local residents' perceptions. Semantic Network Analysis was used after the interviews to identify outstanding keywords and keyword groups derived from each interview. The results demonstrated a shift in perceptions toward landscape components based on the villages each resident belonged to, whereas landscape components, such as agricultural land, rivers and streams, were understood uniformly by decision-makers on a map. Visualising and understanding different perceptions towards fundamental landscape components revealed that residents residing at the upper stream of Upo wetland cared less about the water quality and were more interested in human-induced activities. In contrast, residents of the lower stream of Upo wetland expressed greater concerns about the degradation of water and were less interested in human-induced activities.

1. INTRODUCTION

Recently, awareness of biodiversity and climate change has led to an increase in appreciation of wetlands' ecological and cultural values. Wetlands provide diverse habitats and support different organisms by cycling nutrients, improving soil quality, controlling microclimate, and regulating natural

hazards and pollution with their unique hydrological and biochemical characteristics (Maltby and Barker, 2009). However, we have lost 64–71% of wetlands globally since 1700 AD due to various human activities and development (Davidson, 2014). Since wetlands provide numerous ecosystem services to humans, societies have developed around them for centuries. With the growing technologies and urban expansions, intensive human activities such as agriculture, leisure, and other development occur near wetlands resulting in their degradation.

Wetlands maintain themselves by their unique hydrological connectivity with surrounding ecosystems. Therefore, it is difficult to strictly protect the wetlands from contaminated water channels entering them due to complex land uses and land-ownership patterns along the channels. Presently, decision-making processes for conservation are restricted to a unilateral application of the spatial information on rivers, agricultural lands, and borders of protected areas that allow for clear boundaries and convenient visual presentations. Management of wetlands does not include the complex landscape components and the concept of biosphere reserves, which are recognised as suitable for the long-term development from a social-ecological perspective (Haberl, Winiwarter et al., 2006; Harmáčková and Vačkář, 2015). To manage wetland and surrounding communities appropriately, the landscape approach plays a vital role as it has gained prominence in the search for solutions to reconcile both conservation and development (Sayer, 2009).

The implementation of landscape plans that do not reflect residents' perceptions of landscapes can cause social conflict (Lee, 2020). A landscape is a signifying system created by various relationships in life and contains components connected with individual residents. In rural areas, landscape components interact differently depending on the area of residence, agricultural land conditions, and social characteristics. Residents perceive their relationship with a rural landscape through their experiences beyond its morphological aspects to realise unique values (Lee, 2020; Michelin, Lelli et al., 2005; Paquette, Poullaouec-Gonidec et al., 2005). Thus, it is essential to understand how landscape components are perceived by local residents in each area for their thorough management.

Numerous attempts have been made to apply qualitative and quantitative methods for analysing the perception of local communities near a wetland for its preservation and the enhancement of related (Dobbie and Green, 2013; Jones, Clark et al., 2012; Pedersen, Weisner et al., 2019). Dobbie and Green (2013) have combined the personal construct theory and the photograph survey method to categorise wetland types as perceived by local residents in Victoria, Australia, to conduct a value assessment. Their study focussed on the analysis of visual recognition and public perception of the wetland at the state level and showed that, even for a single wetland, the perceptions of individual humans vary. In addition, Jones, Clark et al. (2012) developed a systematic questionnaire targeting 250 citizens based on their environmental behaviours and perceptions, awareness of water management, and appraisal of social capital for managing two Greek national parks in Ramsar wetlands. They showed that resident communities had a high level of environmental awareness and attached a high degree of significance to both wetlands. Pedersen, Weisner et al. (2019) conducted a quantitative analysis of the cultural services provided by the wetlands located in urban and peri-urban regions to local residents. A systematic questionnaire survey was conducted on 474 subjects, and the analysis was based on verified human psychological factors. The study revealed multiple factors that affect residents' quality of life.

However, previous studies that used qualitative and quantitative methods to analyse human perceptions of wetlands were limited by environmental, human, and sociological factors. Furthermore, the transition of various conditions forms complex relationships with local residents' perceptions, resulting in diverse ranges of perception and resultant quality problems in the analysis. For instance, Jones, Clark et al. (2012) analysed perceptions of the norms for conservation policy from a manager's or a researcher's perspective without considering issues and problems that residents perceive intuitively. Although Pedersen, Weisner, et al. (2019) provided a wide range of cultural ecosystem services for participants to select during their survey, they neglected practical, substantial, and unique cultural ecosystem services that were intuitively perceived by the participants. Moreover, the applicability and validity of previous research studies are limited to particular wetlands with specific spatial scales and surrounding natural and social environments.

To achieve practical environmental planning and management that include surrounding natural systems, humanities, and social environment, the collective and intuitive perceptions of local residents on common landscape components should be defined at an early stage of the decision-making process. Therefore, this study aimed to focus on understanding the perceptions of people residing around the wetland on its landscape components for their coexistence with the wetland.

The purpose of this study was to elaborate on the weakness of designating a wetland as a one-dimensional protected area and to analyse the environmental awareness of local societies associated with an ecologically sensitive Ramsar site. Moreover, by incorporating the opinions of the local residents' intimate relationship to the ecosystem, the study determined to infer their environmental awareness of fundamental landscape components in the study area and, based on these perceptions, to propose a multidimensional approach and careful management of such areas.

2. METHODOLOGY

2.1 Study site

The Upo National Wetland Protected Area (8.61 km2) is known to be the largest inland Ramsar wetland in Korea and includes 13 villages (*Figure 1*). In 2018, these 13 villages were selected as the Ramsar wetland city, the first to be announced by the Ramsar Convention. Therefore, this city attracts global interest in terms of its potential to realise sustainable use and preservation of wetlands with the support of local residents. The 13 villages rely substantially on the natural environment because of the prevalent outstanding balance that exists between ecological, agricultural, and aquatic environments. However, due to the close proximity of the villages' boundaries to the wetland-protected area, institutional and political pressures for environmental preservation have caused one-sided advantages and various conflicts.

The spatial characteristics of the study area are as follows: Flowing through the centre of the 13 villages is the Topyeong Stream, the largest stream flowing into the Upo Wetland. The Topyeong Stream flows into the protected Upo Wetland and is discharged into the Nakdong River, which may disguise it as a single vector; however, since the Upo Wetland is designated as a protected area, the clear distinction enforced between the protected area and outside it has resulted in different managing bodies for the Topyeong

Stream. The protected area is surrounded mainly by agricultural lands, rivers, pastures, and wetlands, and various landscape components such as livestock farms, slaughterhouses, factories, and paved roads are scattered around the 13 villages and pose ecological threats. In such a paradigm, views of various concerned parties converge, including local residents, environmental organisations, ecotourism organisations, local governments, and the Ministry of Environment.

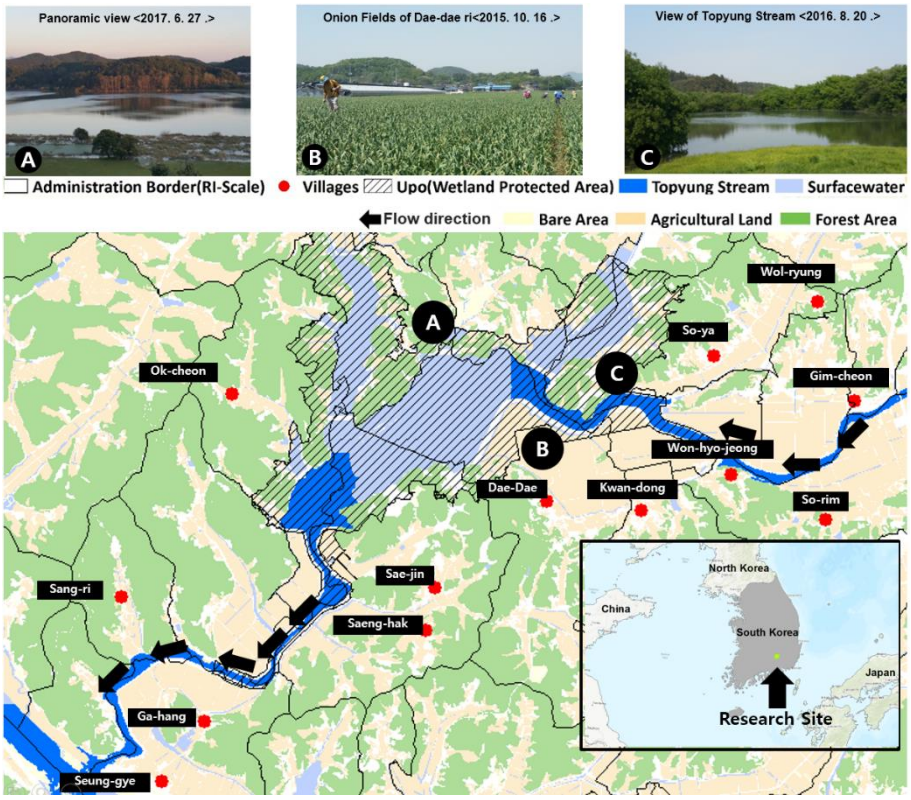

Figure 1. The location of the Study Area in Changnyeong, South Korea

2.2 Material and methods

The study comprised three steps: First, semi-structured interviews were conducted to collect the perception of local residents and generate data. Second, a key network analysis was conducted to objectively analyse the contents obtained from the interviews. Third, interpretation of keywords was obtained using the results of Step 2 (*Figure 2*). A detailed explanation for each step of the research is given further.

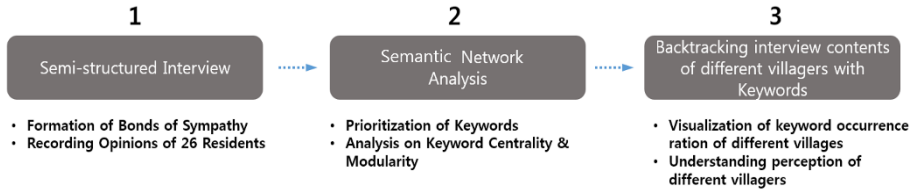

Figure 2. Process of understanding perception of residents of Upo Wetland Community

To understand the perceptions of local residents on the Upo Wetland and its surrounding environment, appropriate subjects were raised for an honest

conversation. To select subjects, we reviewed previous reports and articles published in Korea that describe the environment and Society of the Upo Wetland. A majority of the reviewed literature highlighted limitations such as the Upo Wetland's water and living environments for it to be considered a study site. On one hand, the degradation of the water environment of the Upo Wetland is caused by non-point and point sources of pollution including intensive agriculture, littering, and various factories situated around the wetland (Jun, 2017; Ministry of Environment Korea, 2002; Nakdong River Basin Environmental Office, 2011). On the other hand, the Upo Wetland living environment consists of a wide range of community activities, including cultural and economic activities, which are restricted due to the conservation-oriented policy (Gyeongsangnamdo Development Institute, 2007; Jun, Lee et al., 2019).

2.2.1 Semi-constructed interview

The central cause of the problem and the location from the standpoint of local residents was not considered in the scope of questionnaires applied so far; therefore, this study conducted interviews of the local residents of different villages who live near the Topyeong Stream that flows right across the Upo Wetland. Semi-constructed interviews were designed to identify the prominent landscape components as perceived by the residents of different villages along the stream in an intuitive manner. Therefore, two open-ended questions that are general, relevant, familiar, and empirical while emphasising on the interviewees' sense of responsibility were prepared.

The first questionnaire consisted of two questions: 'Based on your experience, what do you think about the status of the wetland?' and 'What does it mean to you?' These questions were intended to induce the interviewee to express their awareness on the water environment prior to answering the second questionnaire. The second questionnaire consisted of two questions: 'What is it like to live in your village?' and 'What do you experience and feel as a resident of the Upo Wetland community?' These questions were asked to delineate specific landscape components related to the wetland that were perceived by residents of different villages on a regular basis.

Research based on interviews require penetration of social life beyond appearance and clear meanings. Therefore, it is important to establish continuing and fruitful relationships with respondents to address the research problem in depth (Crouch and McKenzie, 2006). Considering interviewees as a sample does not imply individuals of a kind, but rather it indicates variants of a particular social setting. Therefore, the labour-intensive nature of research focused on in-depth understanding can be evoked to justify a small sample size (Crouch and McKenzie, 2006).

In this study, interviews of 26 individuals, including community leaders and ordinary residents, from each of the 13 villages located close to the water zones of the Topyeong Stream were conducted. Community leaders were selected considering that they, as representative decision makers of the village, have an awareness of the village's status and administration. Ordinary residents were selected considering they were the concerned parties who directly experience the effects of administration of village leaders. Based on the competencies of individuals, such as knowledge and experience, the interview time was set between 1 h 30 m and 2 h, with the focus on inducing the open-ended answers to the interview questions. Interviews were conducted once or twice a day, from April to July, when the fields were most intensively used. Specific sites of the Upo Wetland region that were mentioned in the

interview were visited immediately to facilitate discussion on relevant regulations and alternatives. All contents were stored in a voice recorder, transcribed, and interpreted by the author on the same day of the interview.

2.2.2 Semantic network analysis

The uses of a semantic network analysis are increasing, particularly to analyse the relationships between individual keywords within the content and to decipher structures of dialogue and text (Doerfel and Barnett, 1999). In other words, the semantic network analysis is a well-established big data technique, which effectively summarises high volumes of texts from social networking services, media, and other text-based information. Moreover, it is a tool to verify primary keywords based on their frequencies and centrality in a subjective manner (Benckendorff, 2009; Popping and Roberts, 1997).

In this study, content collected from 26 residents of 13 villages were primarily collated to extract keywords. For an accurate keyword analysis, the insignificant adverbs, verbs, adjectives, and keywords with a connotative meaning were excluded from the list. To prevent any missing data, the frequency of the top 50% of keywords were selected based on the differences in the interviewee's competence based on strength of information and language skill (Wang, Shi et al., 2012). In addition, to prevent frequency dispersion of similar words expressed by separate individuals, certain words were integrated into a single, synonymous word; for instance, words such as people, person, and man were combined as human in the refining process.

The final list of selected keywords was applied to the entire interview content to construct the keyword matrix. An analysis of degree centrality (Newman, 2005) was performed using the NetMiner program to analyse the social impact of each keyword mentioned in association with other keywords. The analysis of degree centrality is a method to evaluate the direct impact of a given keyword in a text, which makes it invaluable in studies based on interviews. Subsequently, the analysis of degree centrality was used to extract the most frequently occurring keywords related to the water and living environments of the Upo Wetland that were rooted in the perception of local residents. Among the extracted keywords, those exhibiting a relatively high degree of centrality were selected and used to conceptualise and intuitively interpret the structure of the keyword network using a modularity analysis (Newman, 2006).

The main and derived keywords that were extracted from the keyword analysis were organised into a list, and by applying them to the interview contents of each village, the frequency of the keywords derived from each main keyword were tallied for each village. The ratio of frequency was calculated for the keywords related to water and human. This ratio was applied to each village, and the changes in the perception of local residents living along the Topyeong Stream were reinterpreted.

3. RESULTS

3.1 Keyword Selection based on frequency and centrality

The semantic network analysis conducted for the collated interview contents extracted 2,416 words. Seventy keywords with a clear identity were

selected from the words corresponding to the top half of the cumulative proportion and by excluding adjectives and adverbs (*Table 1*).

The keywords Human, Water, Village, Farming, and the Upo Wetland had the highest frequencies of 443, 419, 204, 158, and 147, respectively. Based on this, the most frequently mentioned keywords, Human and Water, and 68 other keywords (the distinct top 70 keywords) were used in the centrality analysis to extract the main keywords based on clarity of their implications. Among them, the 12 highest centralities were displayed by Human (0.1905), Water (0.1317), Village (0.0886), the Upo Wetland (0.0774), Farming (0.0745), Local (0.0617), Projects (0.0559), Residents (0.0493), City (0.0402), Onion (0.0322), Nakdong River (0.0269), and Water Level (0.0132). The remaining 58 keywords were determined as insignificant because of their large difference in value compared to the 12th highest frequency keyword (Water Level).

Table 1. List of 42 keywords with frequency above 30 as an example for keyword selection while * representing the keywords with outstanding centrality

Keyword	Frequency	Keyword	Frequency	Keyword	Frequency
*Human	443	Herbicide	70	Fishing	42
*Water	419	Management	69	Environment	39
*Village	204	*City	66	Water Level	36
*Farming	158	Rice paddy	65	Compensation	36
*Upo Wetland	147	Past	63	Construction	35
Old days	133	Field	62	Chemical	35
*Local	127	*Nakdong River	60	Japanese crested ibis	34
*Projects	114	Government	55	Development	33
Organic Farming	99	Problem	51	Facility	33
Garlic	87	Land	48	Harvest	32
Grants	86	Garbage	48	Watershed	32
*Residents	83	District	43	Release	31
*Onion	83	Wetland	43	Levee	31
Finance	80	Barley	42	Swamp	30

Note: * Indicates Keywords included in modularity analysis

3.2 Keyword networks of G1 and G2 and their relation to each village

Based on the results of the keyword frequency and the centrality analysis, the keywords Human and Water were used as the centre points for the group analysis of the nine main keywords with respect to G1 (Human) and G2 (Water). The group G1, which was centred on the main keyword Human, comprised the keywords Village, Residents, Projects, Local, and Farming. Since the Upo Wetland was found between Water and Human, it was excluded from the analysis. The group G2, which was centred on the main keyword Water, comprised the Upo Wetland, Onion, City, Nakdong River, and Water Level (*Table 2*). Although groups G1 and G2 were divided based on the two keywords Water and Human, which exhibited the highest centrality, the overall text analysis showed that Water, an essential factor in human life, and Human, who manages water, are intimately related, while the keyword

Village, as an assembly that has to coexist with water, also indicated the formation of a link.

Table 2. Keyword Networks of G1 and G2 with the level of frequency and degree centrality of each

Group	Rank	Keyword	Frequency	Degree Centrality
G1	1	Human	443	0.190476
	2	Village	204	0.088613
	3	Farming	158	0.074534
	4	Local	127	0.061698
	5	Projects	114	0.055901
	6	Residents	83	0.049275
G2	1	Water	419	0.131677
	3	District	66	0.040166
	4	Onion	83	0.032298
	5	Nakdong River	60	0.026915
	6	Water Level	36	0.013251

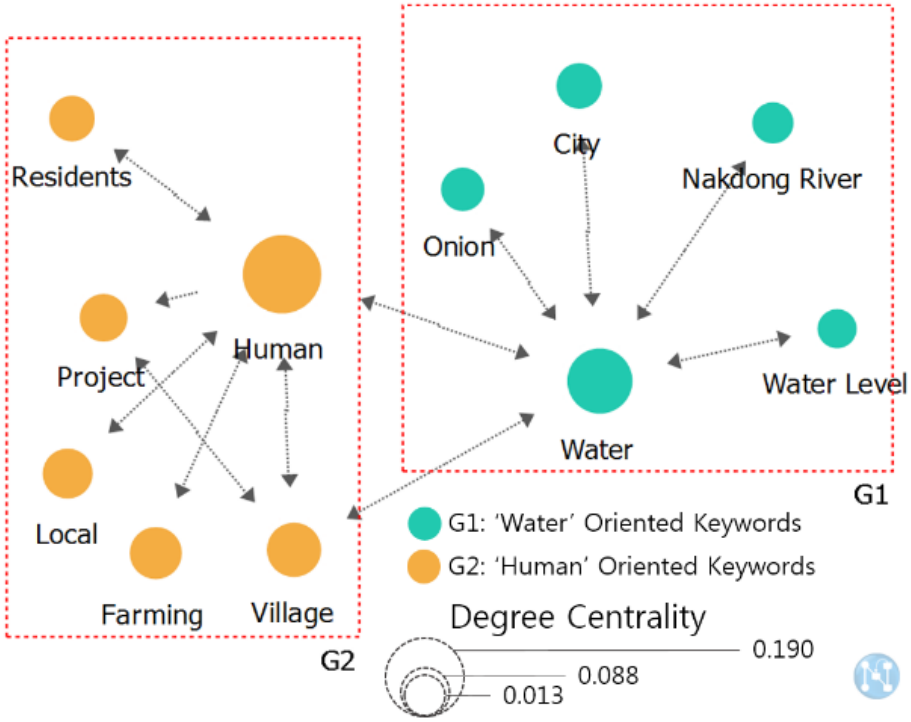

Figure 3. Group analysis of the nine main keywords with respect to Human and Water

Depending on the quantity of the interview contents, the frequency per keyword group was between 83 and 443 for G1 and between 36 and 419 for G2, indicating a large difference. To compensate for such differences, this study examined the ratio of G2 against the sum of the frequency of G1 keywords. The keyword Village showed the highest ratio in G1 (Human) in Sorim village (81%) located upstream of the Topyeong Stream, followed by Soya (78%), Okcheon (76%), Sejin (69%), Gimcheon (65%), Wolryung (61%), Wonhyojeong (58%), Sangri (56%), Kwandong (51%), Daedae (47%), Gahang (43%), Seungkye (30%), and Saenghak (27%). The keyword Village showed the highest ratio in G2 (Water) and was in the reverse order (from Saenghak to Sorim) compared to G1 (Human) (73%) (*Figure 3*).

3.3 Interpretation of landscape components perceived by residents from different villages

To spatialise the frequency ratio of the quantified keywords mentioned by the residents of each village, they were applied to the map showing the flow of the river and the boundary of protected areas, and the resulting diagram of the ratio per group is shown in *Figure 4*.

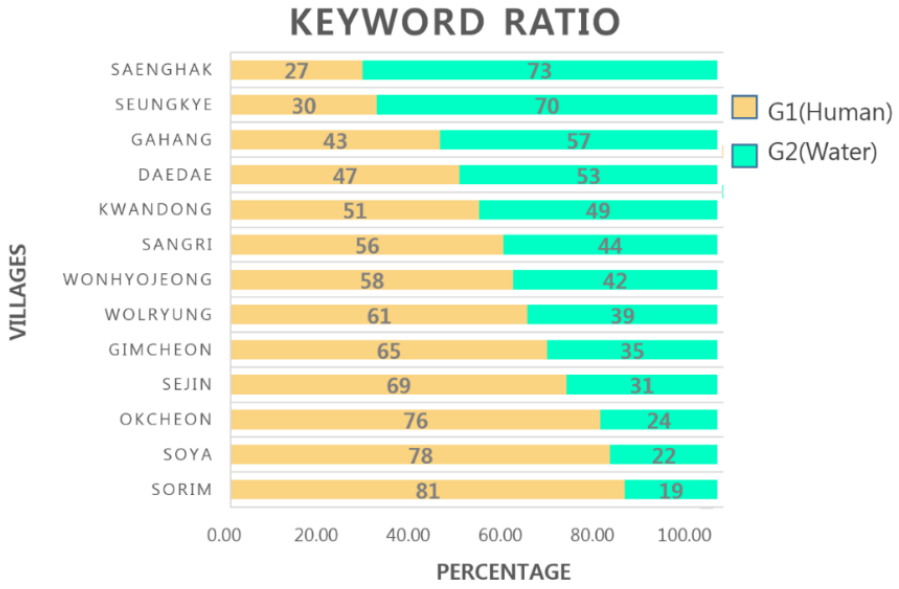

Figure 4. The frequency ratio of the quantified keywords regard to G1 against G2

Applying each keyword to the recorded interview contents for each group showed that most of the related keywords had a close association with the keyword Water, which was linked to the discontent towards the restriction placed on the supply of agricultural water and the degradation of water quality.

In the interview contents related to water, backtracking the keywords Onion, Local, Nakdong River, and Water Level, led to an interesting finding. The keyword Onion showed that similar contents were mentioned in the villages upstream of the Topyeong Stream. When the opinions of most residents were considered, a statement on the unbalanced management of water use emerged as follows: 'Water has to be drawn when onion or garlic is sown or when rice is planted, but the Nakdong River Basin Office does not permit adequate water supply as they have to maintain the water level of the Upo Wetland'. Similarly, a statement for the damage caused by the degradation of water quality emerged as follows: 'The water quality of the Topyeong Stream is not suitable for agriculture. It was alright for rice farming, but for growing onion seedlings, the use of contaminated water sometimes causes them to dry up and die'.

The contents related to the keyword Local most frequently indicated the absence of management by the local government regarding the water surface beyond the protected area as follows: 'At the upstream regions of the Topyeong Stream, garbage dumping and lack of management by the local government on non-point sources of contamination are cutting off water flow and degrading water quality. The search for the keyword Nakdong River indicated the need for a much higher quantity of water due to the drought in agricultural lands caused by the cut-off from the Nakdong River water as follows: 'After you sow onion or garlic, the land is dry. If the land is moist as

normal, only 18 L of water is enough, but when the land is dry like that, more water is needed because the land has to lock in the water to a degree for the rotary to be built. If the water can be drawn in from the Nakdong River or the Topyeong Stream, even a small amount would solve all problems by making the land moist'.

When the keyword Water Level, which is the last keyword associated with water, was backtracked in the search, it was found that the water level regulation of the Upo Wetland had cut off the stream flow, thereby aggravating environmental pollution and causing damages to the farming activities simultaneously as evidenced by the emerging statement as follows: 'When the water level of Upo Wetland is high, a restriction is placed on the use of the water. We feel uncomfortable using the water from the upper village. In the past, water was drawn out and used, and changes in the water level meant that there were many more varieties of water plants and birds'.

In contrast to water, the keyword Human was interrelated with the keywords Village, Farming, Local, Projects, and Residents. A connection with the residents' discontent towards the limited labour and restriction on income-related activities was observed. When the keyword Village was backtracked, the search led to the interview contents mainly collected from numerous villages located far from the Upo Wetland. A resident's economic condition was dependent on cultural activities, environmental characteristics, and the quality of agricultural lands in each village. Regarding this, most of the villagers who were far away from the Upo Wetland complained as follows: 'The villages close to the Upo Wetland have various projects going on, so they receive substantial financial support compared to our village that does not have tourism or promotion-related values' and 'Apart from the compensatory support, each village differs in whether farming turns out successful. This already causes a large difference in land values, but then we get identical regulation.

The search for the keyword Farming showed that most interviewees had a negative perception towards eco-friendly agriculture, as they expressed: 'Even when the local government supports eco-friendly agriculture, the farmers are old, and they don't feel the need because of the uncertainty of securing the market'. When the keyword Local was searched, the local residents in the areas upstream or close to the middle section of the Upo Wetland were discontent that the restriction on economic activities other than the farming activities had brought down land values. Moreover, the lack of management by the local government had resulted in the worsening quality of the water environment of the Upo Wetland as follows: 'The local government says that we cannot build a pasture here or run a restaurant there, not to mention the restriction on the development projects, so land values continue to fall. They put a lot of restrictions, but they don't seem to be doing proper management. The Upo Wetland is continuously being polluted'.

The search for the keyword Projects suggested that even if the local government funded projects in the villages upstream of the Topyeong river and in those close to the Upo Wetland protected area, the local residents lacked the capacity to manage sustainable tourism products because of top–down management projects such as village redevelopment projects. The interview contents implying such a challenge are as follows: 'The local government is providing various funds, but the top-down projects mean that the development is focussed on building facilities, and local residents find it hard to establish such sustainable tourism products'. When the keyword Residents was backtracked, it was found to have been mentioned by most villagers living close to the Upo Wetland, who also pointed out the need for a means of

earning that would replace agricultural activities and help overcome limitations caused by aging and lack of manpower. The most representative statement for this was as follows: 'Most residents here are old, and lack the energy for farming. They need a means of income but they are prevented from doing a trade'.

4. DISCUSSION

4.1 Changes in the perception of local residents with that of stream flow

Previous studies on the changing perceptions of local residents according to the individual's living environment and occupation were mostly reports on apparent cases. Studies based on perception surveys are rare. Diverse landscape components of each region and social and environmental phenomena interact with one another in a unique way, and it is inevitable that local residents living in corresponding regions perceive their living environments in different ways. Thus, a limitation is caused because data are too extensive for objective interpretation with respect to water and living environments mentioned by different residents living in different areas. To overcome such limitations, this study conducted a semantic network analysis, and the results, interpretation, and suggestions for the improvement of management are discussed in this section.

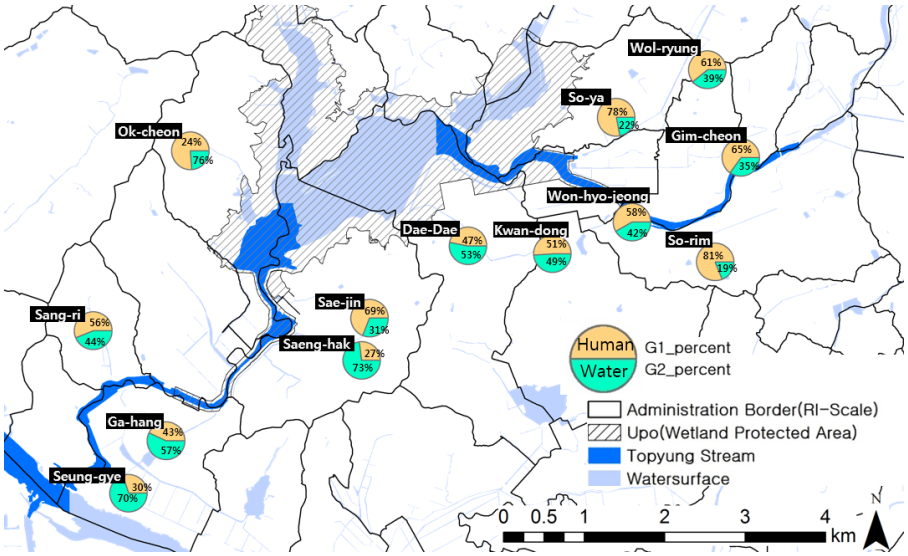

Figure 5. Spatialized frequency ratio of the quantified keywords regard to G1 against G2

The interpretation of landscape components of the water environment as perceived by residents of the Upo Wetland were agricultural activities in association with water quality and living environment. However, the villages displayed marked differences in their perception of water quality and agricultural activities, which could be interpreted in relation to how each section of the Topyeong Stream was managed, its identity, and the conditions of the agricultural lands (*Figure 5*).

The Topyeong Stream originates from Hwawangsan and Balwangsan and flows through the Upo Wetland protected area into the Nakdong River. The Topyeong Stream is managed by two entities depending on the designated

protected areas. The protected areas of the Topyeong Stream and the Upo Wetland are managed by the Nakdong River Basin Office of the Ministry of Environment, while the Topyeong Stream beyond the protected areas and other agricultural lands are managed by the local government. The separation of management systems of an identical and interconnected environmental factor because of the designation of protected areas may lead to various conflicts (*Table 3*).

Table 3. Shift in perceptions of residents based on their belonging communities at different stream location.

Perception of Residents	Communities (Location)		
	A (Upper)	B (Middle)	C (Lower)
Funding for alternative Economical Activities	X	O	X
Quality of Water Resource for farming	High	Moderate	Low
Land-use restriction	Low	High	Low

4.2 Interpretation of the present condition of different communities along the Topyeong Stream

The upstream regions of the Topyeong Stream are not protected areas, and hence, they are managed by the local government. High concentrations of biochemical oxygen demand and suspended solids were observed in the upper regions compared to those in the lower regions of the Topyeong stream (Jun, 2017), and the use of the river water is free. Therefore, within region A, the residents do not face problems in terms of economic activities such as farming and leisure activities, as land-use restriction is much weaker than that of the protected area. However, the upstream regions of the Topyeong Stream, where land-use restriction is relatively weak, are exposed to unregulated land use, which has a direct impact on the Upo Wetland and hence require stronger regulations and continuous monitoring. Nonetheless, the residents of the upstream region of the Topyeong Stream showed a deeper interest in land values of their agricultural lands or for funding of regional projects based on the free accessibility to the stream. It is essential that awareness of local residents on indiscrete land use that produces non-point pollution sources should be improved (*Figure 6*).

As the Topyeong Stream flows into the wetland protected area, region B faces more intense control over land use and environment, and hence, it faces varied problems. First, the protected areas are not managed by the local government but by the Nakdong River Basin Office (Ministry of Environment) such that powerful preservation policies are applied. The designation of the protected area prevents local residents in region B from continuing to live or conduct cultural activities in the region, although they can freely access the Topyeong Stream and the Upo Wetland. In addition, because land use is restricted to farming activities, resulting in residents becoming solely dependent on agriculture, the region is funded for promoting ecotourism projects. In reality, region B already consists of an aging community, and it is difficult to sustain agricultural activities, which need intense labour. Furthermore, owing to the lack of training and experience in ecotourism projects, the independent management of such projects by the local residents is limited. Problems associated with the water environment in region B are also critical. Controls on water levels and restrictions on the flow within the protected area exerts a negative influence on the living environment

of other regions. Most importantly, the stream flowing in from the upstream region A of the Upo Wetland, with relatively free access to land use, contains various floating substances that become stagnated in the Upo Wetland during the period of water-level control implementation, and hence, water quality deterioration aggravates and results in malodour and waste accumulation.

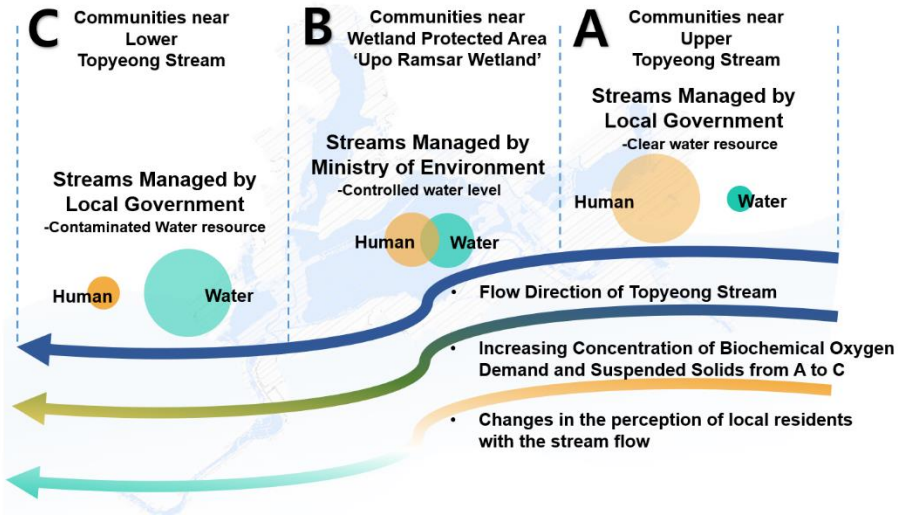

Figure 6. Conceptual diagram of the changes in perception of local residents with the stream flow

Such deterioration of the water environment is directly linked to region C, where the most complex damages occur. The local government manages region C as it does not belong to the protected area. Like region A, the land use in region C is more accessible than that of region B. The difference between regions C and A is apparent in terms of the water quality of the Topyeong Stream. The water of the Topyeong Stream that flows into region C has already spent considerable time in stagnation such that it is unusable for agriculture. Compared to region A, proximity to the wetland-protected area implies only partial application of regulations on land use. Moreover, region C differs from region B in that its ecological values have not been recognised, which limits financial support for ecotourism, and a practical means for living is urgently required here.

4.3 Strengths and limitations of analysis on collective perception

At present, online Society enables a multitude of opinions that are shared freely. With the advancement of technology and ageing at the same time, the use of communication technology by the elderly has steadily increased (Hunsaker and Hargittai, 2018). However, in a rural community where people are more familiar with outdoor activities, the use of communication technology is relatively low, especially as it requires a basic knowledge of computers (Anderson and Perrin, 2017; Hunsaker and Hargittai, 2018), which limits the means of communication. In this study, the average age of the interviewees was 65 years. They were all engaged in farming and had a low-level understanding of smart phones or computers. However, interestingly, the residents in the upstream and downstream areas of the Topyeong Stream perceived the Upo Wetland water environment and their own living environment in distinct ways. Moreover, the water quality of the Topyeong

Stream was equally perceived by the residents in close association with their perception on agricultural lands. The perceptions of the residents of each village regarding the Topyeong Stream and agricultural lands are associated with various social phenomena, indicating that these two were the most important landscape components interacting with the living environment. These two factors must be periodically considered by managers and policymakers concerned with the Upo Wetland to improve water quality and enhance the quality of life in the local environment.

This study has two limitations. First, the process of refining the contents of the interviews required a long duration. The study results are restricted solely to the environments perceived by the local residents, and hence, interaction among concerned parties during the decision-making process may be difficult. Second, the analysis could not include all keywords mentioned by the interviewees. At the onset, this study had restricted the number of keywords to 70 to prevent complications in the analysis and restrict the variability in the results. Nevertheless, various keywords and the groups formed by them were extracted, which is likely to enable the selection of more diverse management targets.

5. CONCLUSIONS

How can the decision-making process for environmental management reflect the environmental awareness of local residents that have the most thorough understanding of their living environment to maintain a sustainable environment and Society by minimising conflicts? This question provided the motivation for this study. The perception of any phenomenon by humans drive specific actions. In rural areas with human occupation, diverse landscape components cooperate and interact with one another to create varying environments. Humans notice and perceive such environments and take actions. Hence, the main environmental factors perceived by the residents in their daily lives can be analysed by backtracking issues and words expressed by local residents based on their perceptions in interviews.

This study presents an objective set of data on major landscape components that should be continuously monitored for pursuing various activities such as ecotourism and eco-friendly agriculture. Such activities require the participation of local residents, not only in the Upo Wetland region, but also in other regions with high ecological values, where elderly people are predominant in the population. The landscape components presented in this study are physical elements that are identified by the local residents. Thus, further studies related to spatial planning and sustainable development may utilise the proposed process, which promotes pro-active participation of local residents to identify the significant landscape components. The results of the process can be used as inputs for public participatory GIS items during the process of direct mapping of landscape components. In addition, major landscape components may be classified into more diverse categories based on social and environmental conditions. Specific districts are likely to contribute to more uniquely compartmentalised spatial data during the process of differentiation of ecosystem service assessment at local and site scales. Furthermore, it is anticipated that a contribution will be made to the decision-making process demarcating areas of minimum use of communication technology such that the opinions of the many socially vulnerable citizens may be taken into consideration.

AUTHOR CONTRIBUTIONS

Conceptualisation, B.J., J.L. and Y.S.; methodology, J.L. and B.J.; software, B.J.; investigation, B.J.; resources, B.J.; data curation, B.J.; writing—original draft preparation, B.J.; writing—review and editing, B.J.; supervision, Y.S. All authors have read and agreed to the published version of the manuscript.

ETHICS DECLARATION

The authors declare that they have no conflicts of interest regarding the publication of the paper.

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REFERENCES

Anderson, M., and Perrin, A. (2017). "Technology Use among Seniors | Pew Research Center". *Pew Research Center*.

Benckendorff, P. (2009). "Themes and Trends in Australian and New Zealand Tourism Research: A Social Network Analysis of Citations in Two Leading Journals (1994–2007)". *Journal of Hospitality and Tourism Management*, 16(1), 1–15. doi: https://doi.org/10.1375/jhtm.16.1.1.

Crouch, M., and McKenzie, H. (2006). "The Logic of Small Samples in Interview-Based Qualitative Research". *Social Science Information*, 45(4), 483–499. doi: https://doi.org/10.1177/0539018406069584.

Davidson, N. C. (2014). "How Much Wetland Has the World Lost? Long-Term and Recent Trends in Global Wetland Area". *Marine and Freshwater Research*, 65(10), 934. doi: https://doi.org/10.1071/MF14173.

Dobbie, M., and Green, R. (2013). "Public Perceptions of Freshwater Wetlands in Victoria, Australia". *Landscape and Urban Planning*, 110, 143–154. doi: https://doi.org/10.1016/j.landurbplan.2012.11.003.

Doerfel, M. L., and Barnett, G. A. (1999). "A Semantic Network Analysis of the International Communication Association". *Human Communication Research*, 25(4), 589–603. doi: https://doi.org/10.1111/j.1468-2958.1999.tb00463.x.

Gyeongsangnamdo Development Institute. (2007). *"Establishment of Master Plan for Restoratoin and Conservation of Upo Wetland"*. Gyeongsangnamdo Province.

Haberl, H., Winiwarter, V., et al. (2006). "From LTER to LTSER: Conceptualizing the Socioeconomic Dimension of Long-Term Socioecological Research". *Ecology and Society*, 11(2), art13. doi: https://doi.org/10.5751/ES-01786-110213.

Harmáčková, Z. V., and Vačkář, D. (2015). "Modelling Regulating Ecosystem Services Trade-Offs across Landscape Scenarios in Třeboňsko Wetlands Biosphere Reserve, Czech Republic". *Ecological Modelling*, 295, 207–215. doi: https://doi.org/10.1016/j.ecolmodel.2014.10.003.

Hunsaker, A., and Hargittai, E. (2018). "A Review of Internet Use among Older Adults." *New Media & Society*, 20(10), 3937–3954. doi: https://doi.org/10.1177/1461444818787348.

Jones, N., Clark, J. R. A., et al. (2012). "Local Social Capital and the Acceptance of Protected Area Policies: An Empirical Study of Two Ramsar River Delta Ecosystems in Northern Greece". *Journal of Environmental Management*, 96(1), 55–63. doi: https://doi.org/10.1016/j.jenvman.2011.10.012.

Jun, B., Lee, J., et al. (2019). "Spatial Cognition of Residents towards the Conservation Area of Upo Wetland." *International Review for Spatial Planning and Sustainable Development*, 7(1), 50–65. doi: https://doi.org/10.14246/irspsd.7.1_50.

Jun, T. S. (2017). "Topyeongchon Water Quality Flow Into and Out Upo Wetland". *Research Institute for the Railway Convergence Technology*, 4, 157–166.

Lee, C.-H. (2020). "Understanding Rural Landscape for Better Resident-Led Management: Residents' Perceptions on Rural Landscape as Everyday Landscapes". *Land Use Policy*, 94, 104565. doi: https://doi.org/10.1016/j.landusepol.2020.104565.

Maltby, E., and Barker, T., eds. (2009). *The Wetlands Handbook*. Oxford, UK: Wiley-Blackwell.

Michelin, Y., Lelli, L., et al. (2005). "Development Project : New Perspectives for the Organisation of Local Participatory". *Ecology*, 6(1), 19–32.

Ministry of Environment Korea. (2002). *"Upo Wetland Natural Ecosystem Conservation Area"*. Ministry of Environment Korea.

Nakdong River Basin Environmental Office. (2011). *Conservation and Utilisation Plan for Upo Wetland Protection Area*. Nakdong River Basin Environmental Office Korea.

Newman, M. E. J. (2005). "A Measure of Betweenness Centrality Based on Random Walks". *Social Networks*, 27(1), 39–54. doi: https://doi.org/10.1016/j.socnet.2004.11.009.

Newman, M. E. J. (2006). "Modularity and Community Structure in Networks". *Proceedings of the National Academy of Sciences*, 103(23), 8577–8582. doi: https://doi.org/10.1073/pnas.0601602103.

Paquette, S., Poullaouec-Gonidec, P., et al. (2005). "Le Paysage, Une Qualification Socioculturelle Du Territoire: Material Culture Review".

Pedersen, E., Weisner, S. E. B., et al. (2019). "Wetland Areas' Direct Contributions to Residents' Well-Being Entitle Them to High Cultural Ecosystem Values". *Science of The Total Environment*, 646, 1315–1326. doi: https://doi.org/10.1016/j.scitotenv.2018.07.236.

Popping, R., and Roberts, C. W. (1997). "Network Approaches in Text Analysis". In *Classification and knowledge organisation* (381–389). Berlin, Heidelberg: Springer Berlin Heidelberg.

Sayer, J. (2009). "Reconciling Conservation and Development: Are Landscapes the Answer?" *Biotropica*, 41(6), 649–652. doi: https://doi.org/10.1111/j.1744-7429.2009.00575.x.

Wang, D. J., Shi, X., et al. (2012). "Measurement Error in Network Data: A Re-Classification". *Social Networks*, 34(4), 396–409. doi: https://doi.org/10.1016/j.socnet.2012.01.003.