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Which urban and landscape qualities make Arctic villages attractive? The Torne River villages in Sweden

Stefano Tornieri[a,b], Jing Ma[a] and Agatino Rizzo[a]

[a]Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Luleå, Sweden; [b]Departments of Architecture and Arts, University Iuav of Venice, Venezia, Italy

ABSTRACT

Throughout history, small village communities in the Arctic have developed several strategies to ensure their survival. Along the Torne River, some fishing communities have produced specific architectures, landscapes, and social strategies to support their communities and survive for centuries. However, depopulation, aging, climate change, and the expansion of the extraction industry are threatening these villages. The hypothesis is that traditional fishing villages situated alongside rivers possess architectural, urban, and social attributes that can enhance outdoor activities linked to water and green spaces and enable the long-term social sustainability of Arctic villages. The innovative approach of the paper involves combining a mapping methodology of green and blue infrastructure with the architectural, urban, social and historical values of a place to identify design strategies for improving attractiveness demonstrating its efficacy, particularly in small, local-scale villages. The paper investigates the villages of Kukkola and Korpikylä taken as emblematic examples and explores the architectural and landscape value in relation to the green–blue infrastructure.

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Green–blue infrastructure; Arctic towns; attractivity; outdoor recreation

1. Introduction: literature review

The Arctic is going through a period of intense change triggered by climate change, natural resource exploitation, and migration trends. The melting of ice and permafrost, and warmer temperatures are creating new opportunities to extract resources (Kröger 2023). Resource extraction and the availability of cheap energy in the arctic (hydropower, wind, and in the future hydrogen) promises to create new jobs and attract thousands of new inhabitants after decades of youth out-migration and aging (Knox and Mayer 2013).

1.1. Migration phenomena in the Arctic

Historically the Arctic has been a place for resource extraction (wood, furs, etc.) and shipment to the centres of national economies, e.g. capital and industrial cities (Elenius 2015). The industrialization of resource extraction during the first part of the twentieth century

CONTACT Stefano Tornieri stornieri@iuav.it, stefano.tornieri@ltu.se Luleå University of Technology, Luleå 97187, Sweden; University Iuav of Venice, Santa Croce 191 Tolentini, Venezia 30135, Italy

has multiplied the scale of extraction and it has required a new workforce that was not originally located in the region. In Sweden, the twentieth century saw the establishment and gradual consolidation of the 'Norrbotten Technological Megasystem' (Hansson 1998), a 400 km infrastructure corridor consisting of railways, ports, power plants, and extraction sites. As a result of these huge investments, indigenous Arctic communities have seen the rise of intra-national and inter-national migration to attend to the tasks of their growing resource industries, often generating conflicts between traditional land uses (e.g. Sami herders) and new ones (e.g. mining) (Morata et al. 2020; Rizzo and Sordi 2020). During this period, several existing villages in the Arctic attracted new settlers such as in the cases of Kiruna and Gällivare. From small villages, towns and larger villages such as Kiruna and Gällivare transformed into growing, industrial towns that attracted thousands of workers from other parts of Sweden, Scandinavia and the rest of the world.

1.2. Technology and shrinking

However, the demographic growth trajectory (Figure 1) of these towns began to change from the end of the 1960s, when technological innovation, overproduction, and the beginning of de-industrialization in the West triggered a population shift from industrial centres to service ones (Rizzo, Sjöholm, and Luciani 2023). As shown by Arboleda (2020) in Chile, the resource extraction of today is a highly technological and automated business, requiring, when compared to the past, much less labour force and more remote engineering jobs. In aggregate terms, regions like Norrbotten, have never recovered by population de-growth triggered from technological development in mining extraction during the 1970s.

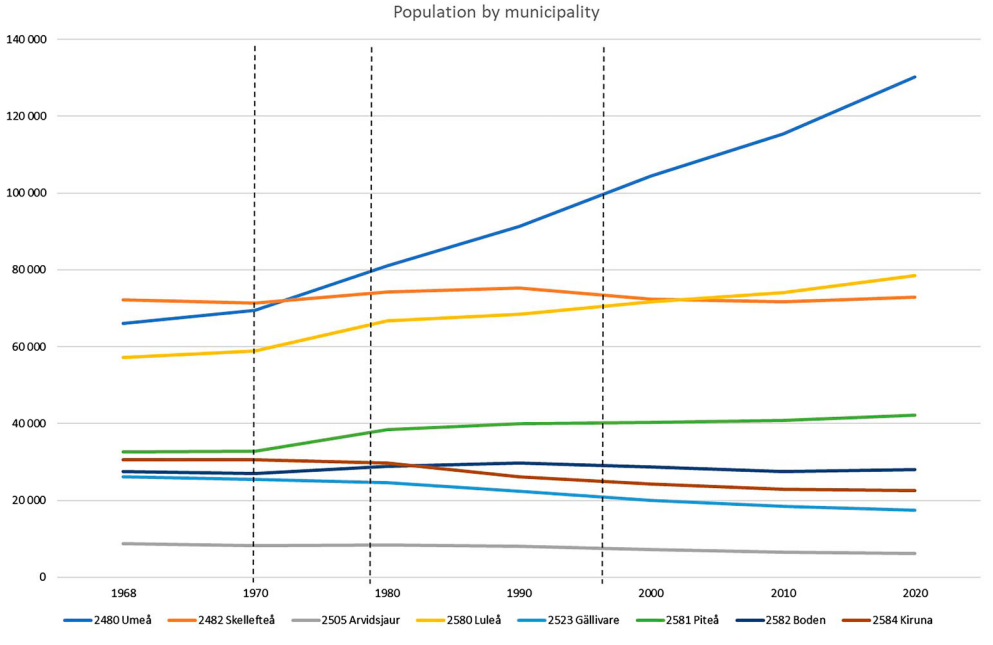

Figure 1. Demographic evolution of municipalities in Norrbotten. Data source: SCB Statistika Central Byrå.

The demographic decline has resulted in some intra-regional migration from land-locked small towns and coastal cities by the Baltic (Luleå, Umeå, etc.) and from the North to the South. Swedish Arctic towns such as Pajala, Overkalix, and so forth are dealing with long-standing emigration of youth, a higher proportion of elders, and low tax resources to take care of them. Also changes in education preferences, gender independence, and life-style have pushed youth and especially young women out of inland Arctic towns, in search of opportunities in more attractive cities located either by the Baltic or to the South of the country (chiefly in Stockholm and Gothenburg).

1.3. Fly-in fly-out and city attractiveness

The fly-in fly-out phenomenon in the resource extraction business, i.e. the practise, quite common in the offshore oil industry of nearby Norway (Korneeva 2022), to outsource workers from far away places and working in shifts of two or three weeks, is a big challenge for the tax-funded welfare of Arctic towns (Markey, Storey, and Heisler 2011). In countries such as Sweden, characterized by a two-tier system, a strong state and independent municipalities, the competition to attract new inhabitants and expand the tax base negatively affected rural and Arctic towns where a clear shrinking population pattern can be detected. Since the neoliberal reforms of the 1990s, municipalities have been locked into a fierce win-lose competition to attract businesses and in turn potential inhabitants from which to expand their tax base (Bristow 2010).

1.4. Green transition and growing investments in Arctic centres

Fast forwarding to the last decade, the need for critical minerals and the transition of the extraction industry to a carbon neutral economy is unleashing a new wave of investments in the north. Norrland Resources, a mining company that bankrupted in Pajala while trying to mine iron ore, has recently resurrected with a new company structure and an aggressive advertising campaign to nudge local authorities to allow extraction in the area of Kaunisvaara. Similarly, LKAB (Luossavaara-Kiirunavaara Aktiebolag) has recently found evidence of rare earth deposit in new areas which on the other hand could risk sparkling a new conflict for land with the local Sami communities. The promise of a new 'klondike era' (as locals often label it), triggered by the implementations of the Sustainable Development Goals and the energy transition in Europe, is luring local politicians into making risky investments to attract new businesses and residents. Meanwhile the arctic civil society is worried about the economic, environmental, and social costs if these investments will fail.

1.5. Villages and Arctic qualities

In this paper we focus on sparsely populated villages that, unlike larger and more organized city centres (e.g. Luleå, Piteå, Gällivare, etc.) are most at risk to miss the opportunity of the green transition and to attract and retain inhabitants for keeping alive the local welfare (doctors, schools, etc.) (Figure 2). Recent research on 'lifestyle' migrants (Lundmark, Carson, and Eimermann 2020), has documented some practical solution to the decline of rural villages in northern Sweden.

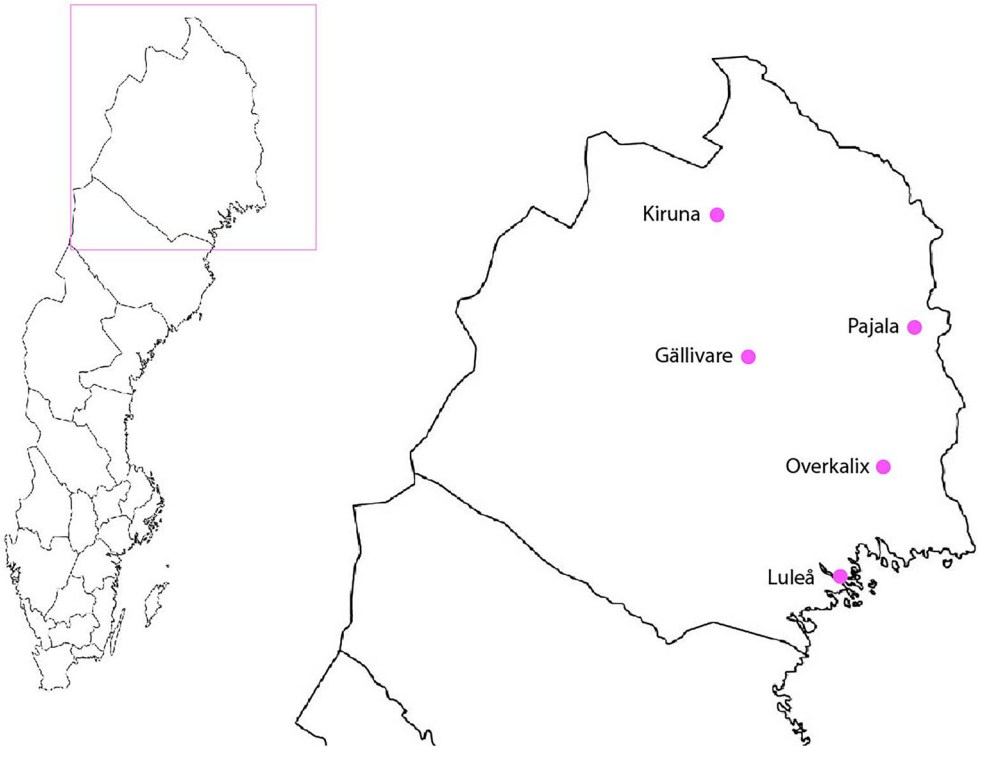

Figure 2. Location of the sparsely populated cities in Norrbotten.

Most recent immigration to Sweden has focused on urban areas and when immigrants arrived in rural areas, they often left for cities. Possibilities to leverage the peculiar qualities of the Arctic rural periphery ('real winter', access to large outdoor spaces, nature and clean air and water, etc.) has enticed new lifestyle immigrants to relocate and to start small-scale tourism activities (Carson, Carson, and Eimermann 2018). However, as shown by Hedlund et al. (2017), not all newcomers are able to integrate in the socio-economic structure of the Swedish countryside.

1.6. Aim and questions in this paper

The purposes of the paper is to identify and assess which qualities (e.g. architectural, urban, and social) are important for attracting much needed new residents to the north. Theoretically and methodologically we deploy indicators and approaches developed in blue–green infrastructure theory and ecosystem service assessment to engage with trends such as aging populations, shrinking villages, community engagement, and tourism that are important to ensure high quality of life and well-being for new comers. Our question is: Which of these qualities potentially foster community engagement and increase the overall appeal of these areas in the future? To answer this question, we use a mixed method approach that is based on mapping the geographical, ethnographic and architectural qualities of two villages/case in the Swedish Arctic.

2. Methodology

Green blue infrastructure (GBI) has been recognized as interconnected natural and designed landscape components. This concept encompasses a variety of land uses, including parks and reserves, private gardens and backyards, waterways and wetlands, greenways, forests, and ranches (Bellezoni et al. 2021; Ghofrani, Sposito, and Faggian 2017). Characterized by interconnected vegetation and water bodies, GBI (Green Blue Infrastructure) is increasingly acknowledged for its potential in fostering climate change adaptation and resilience (Sturiale and Scuderi 2019). However, the predominant research on GBI has been conducted mainly by ecologists and is often focused on regional scales (Ramyar, Ackerman, and Johnston 2021). Featuring connected vegetation and water bodies, GBI delivers multiple ecological, social, and economic benefits and serves as an approach that communities can apply to protect and restore functioning ecosystems towards sustainable land use. These include enriched habitat and biodiversity, maintenance of healthy waters, increased recreational and tourism opportunities, improved public health, and a better connection to nature and a sense of place (Benedict et al. 2012; Ghofrani, Sposito, and Faggian 2017).

In Sweden, outdoor activities such as fishing, are considered important land and water use activities, and are associated with key societal benefits, such as increased environmental awareness, public health, local development, and inclusive and cohesive community (Andersson et al. 2019; Emmelin et al. 2010; Ma and Haarhoff 2015). However, there is limited knowledge of the drivers behind outdoor recreational activities and their quality, especially in places related to water bodies such as lakes, rivers and coasts. The cold climate with long, snow-filled winters creates an even more unique precondition and requirement for BGI in the Nordic countries (Öhrn Sagrelius et al. 2022). As a result of the dramatic changes in temperature and precipitation quality from summer to winter, one of the main challenges is to fulfil the social requirement of increasing attractiveness in small villages in these regions. Using the framework of GBI for multifunctionality is an important approach in designing planning processes from a social-ecological perspective. It would support the GBI in effective planning practice to combine ecological and social perspectives. This research explores both the social and ecological components of GBI, integrating biodiversity, health, wellbeing, and tourism. It establishes a conceptual framework that connects the various functions of GBI at the local scale with future recommendations for the sustainable development of Arctic fishing villages. Additionally, a new assessment of these fishing villages will be conducted, focusing on the improvement of GBI.

2.1. Biodiversity conservation

Studies have been conducted on the local benefits of GBI in cities regarding increasing biodiversity (Handley, Pauleit, and Gill 2007). Conservation and planning studies of biodiversity often call for the creation of ecological networks that connect in an urban setting (Benedict et al. 2006). These networks of green spaces, wetlands, woodlands, and parks provide shelter for wildlife and rare species. Larger green spaces tend to offer more resources and habitat types. To make GBI an efficient approach to urban development, new strategies for distributing information, legislation, and recognizing of the role of nature in towns and cities must be established (Mansur et al. 2022).

2.2. Health and wellbeing

The contact between humans and nature is crucial for people of all ages. GBI improves the mental and physical health of urban populations by making it possible for people to interact with nature at home and at work (Depietri and McPhearson 2017). For instance, the presence of aesthetically pleasing urban parks increases physical activity, social cohesion, and positive mental stimulation and reduces the incidence of diseases such as obesity, depression, and attention deficit disorders (Bratman, Hamilton, and Daily 2012; Grinde and Patil 2009).

2.3. GBI and tourism

Riverside villages and communities in Sweden and Finland face challenges as they seek to develop their riverfront activities for economic growth, place identity, and tourism. As part of a natural network, GBI elements have been studied mostly for their ecological and environmental functions, e.g. purifying urban water, mitigating urban runoff water, and maintaining biodiversity (Chiesura 2004; Gómez-Baggethun and Barton 2013). Social and cultural functions and services from GBI concerning smaller riverside towns and villages in Nordic countries have not yet been widely investigated. These riverside towns and cities can potentially improve fishing tourism and leisure functions to promote historical interest and cultural attractions through local festivities (Xie & Gu, 2015). Based on Bastian, Haase, and Grunewald (2012), Díaz et al. (2011), and Ernstson (2013). The conceptual framework of the study is established in three main phases: the identification of qualities, assessing the qualities, and the interpretation of findings. The overall framework for assessing the multifunctionality of GBI in this paper (section 4) is structured through a multi-perspective analysis that includes ecological, social, and architectural aspects, cross-referenced with hotspots of multifunctionality taken from the GBI maps, the local community's demands, and the local government's preferences to produce planning strategies that promote attractiveness. Considering both perspectives from ecological and social points of view, priorities and recommendations for strategies and actions are proposed in the third aspect (Figure 3).

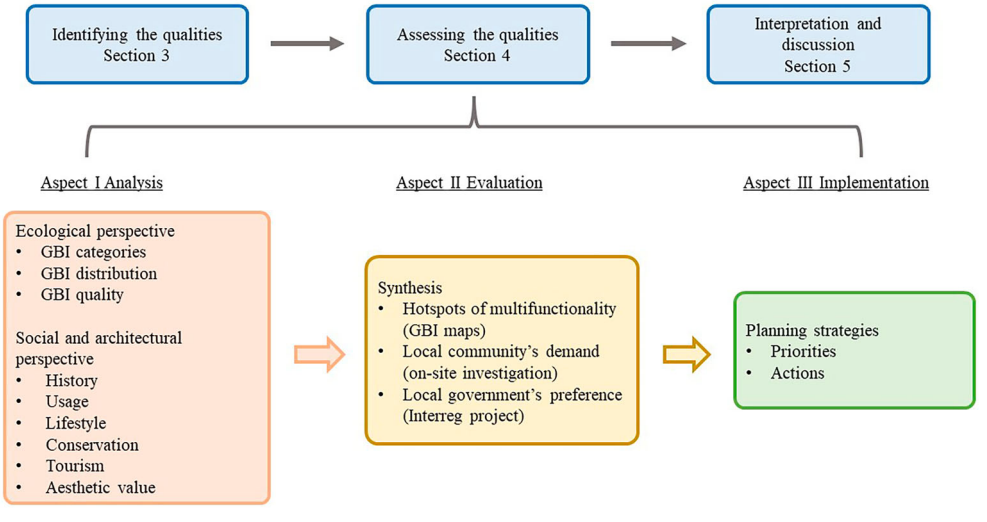

Figure 3. Conceptual framework/model for the application of the GBI.

3. Case study: the fishing communities along the Torne River

3.1. Geographic and ethnographic aspects, the importance of the river for human settlement throughout history

The importance of free-flowing rivers that allow free movement of water, sediment, fish and other organisms is increasingly recognized by the EU's environmental policy, particularly the Water Framework Directive and the Biodiversity Strategy for 2030. The continuity of river flow supports the complex life cycles of many aquatic species and ensure a functioning ecosystem, riparian vegetation is also vital for river ecology (Belletti et al. 2020). It requires continuity because the land alongside fluvial systems interact with the river and associated processes as results from co-construction by human and natural processes (Dufour, Rodríguez-González, and Laslier 2019; Riis et al. 2020). The Torne riverbed, as a crucial component of the GBI, has been chosen as the focal area for this case study due to its diverse topographic courses, which plays a significant role in supporting a healthy and varied biodiversity. Regarding the analysis aspects, the ecological perspective has been analysed using an ArcGIS map from the National Mapping Services (herkules.slu.se). Some communities have settled on the banks of the river, and their main activity was fishing for salmon and whitefish according to the season. Fishing villages were also present along the Kalix River in Sweden and Kemi River in Finland (AA.VV 1965). Aligned with the conceptual framework of GBI, this study focuses on examining the social and architectural aspects of the fishing villages located along the Torne River, on the border between Sweden and Finland. Our case study area was considered for the completeness of historical documentation completeness, architectural heritage value, and recent touristic interest to understand the multifunctionality of GBI, perspectives from the local communities and the plans for development from local government's point of view. A complete map of the Torne River fisheries has been drawn by Ingrid Vallin in collaboration with Ingalill Grandlund based on the documentation by Ingemar Sorensen (Norrbotten Museum), fisheries inspector in the upper northern district Luleå. The map displays the villages' locations and categorizes the salmon fishing techniques into four classifications according to Grandlund: Karsina-weirs, seine technique, Strandpata, and Mockpata. Overlapping the location of the villages and characteristics of the river flow, a relationship between the type of fishing technique and the hydrodynamics is evident (Figure 4). Fishing techniques such as dipnetting were able to be employed successfully in proximity to rapids due to the tendency of fish to pause in areas of decreased water velocity behind stones as the current rises. For this research we focus on the examples of Kukkola and Korpikylä as tangible and living settlements, in which dipnetting technique, and a consistent variety of specific architectures related to fish, have been used for centuries and are still present today.

For centuries, fishing communities near the Torne River developed a distinct fishing system, which became known as dipnetting. Characterized by a single person fishing from the shore or off of specially constructed piers, dipnetting is a traditional, resource-sparse technique. The main tool is called 'lippo', dipnet, which is a bag-like net, 40, 45 cm wide, at the end of a log rod, 3 metres approximately. In the past the 'lippo' was built from fir and the net from cotton but nowadays synthetic materials like fibreglass and nylon are used. Environmentally friendly techniques have developed

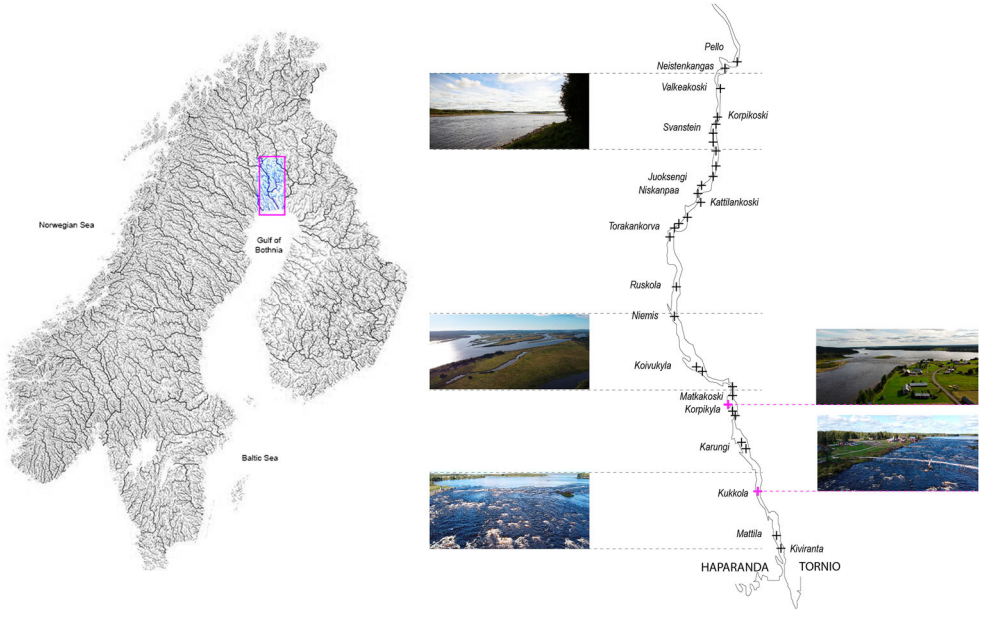

Figure 4. Location of the Torne River; fishing villages according to John Granlund survey, with different river sections and the locations of the Kukkola and Korpikylä villages.

on the spot and remained unchanged for long, as described since the twentieth century by the Finnish ethnologist T. Sirelius (1906) who documented the fishing activity and the construction of several wooden piers at specific points of the riverbanks. The role of river management in relation to fishing rights is crucial, and it must be viewed as a matter of human rights. This approach would integrate fisheries governance into a wider human rights perspective, leading to outcomes that promote both human development and resource sustainability (Allison et al. 2012). The Swedish ethnologist John Granlund showed the process of transformation from uncontrolled and individual fishing to a system organized and controlled by the Crown. After they came under Swedish jurisdiction, the mobile groups of the fishing culture were transformed into more local ones, concentrated in a small number of places and conducted by large fishing teams. Granlund also noticed that each fishery functions as an independent unit and the aim of the group (family) is to improve its member potential through a multifarious economy. Owners of the land used the woodlands for hunting, fishing and for a kind of extensive agriculture and the fishing activity was connected to the land property rights and the tax required by the crown. From a cultural perspective, the requested tax, referred to as a fee, marks the entry of the fishing and hunting culture into the civilization, making the salmon catching in the Torne River a branch of the industry regulated by the State. The local farms and their owners also own the fishing rights which cannot be sold to foreign people. During the fishing season, the locals organize activities related to fishing such as building wooden piers, maintaining and repairing traditional village buildings, organizing fishing rounds and organizing the sharing events each evening during the whitefish season. During the whitefish season, from June to mid-September, the shift between fishermen

during the day is organized by an informal meeting that occurs every day at 6PM near the river. During this event, considered a daily ceremony, the catch from the past 24 h is shared between farmers. The gathering is organized outdoors, normally close to the riverbanks. Fishes are prepared and carefully grouped on the ground by an owner who ensures the most uniformity as possible in terms of numbers and dimensions of fish. Small-scale fisheries remain important for employment and food security (Béné et al. 2007, 2016). The contribution of self-regulation related to fishing rights is critical to shift to the idea of integrated systems of people and environment as social-ecological systems, rather than merely as ecosystems (Ommer et al. 2010).

3.2. Architectural aspects: vernacular architecture as a connecting system between humans and GBI

The social and architectural aspects data were derived from a combination of qualitative data extracted from interviews with local inhabitants, information collected on-site (such as names and functions of traditional buildings), and historical maps from the Norrbotten Museum Archive (Table 1). The traditional landscapes of the rapid fields consist of constructions and buildings made for fishing. In the case of Kukkola and Korpikylä two different urban compositions are visible. The comprehensive data pertaining to functions, site building organization, traditional taxonomy, and architectural details has been derived from a series of field research visits conducted during the months of August and September 2022. The qualitative approach employed encompassed direct on-site investigations, included a drone flight, an interview conducted with local inhabitants after a day of fishing, and data extraction from the Interreg project's dedicated website titled 'Summer, Whitefish & Torne River: The Whitefish and the Living Fishing Culture of Torne river – the Border River between Finland and Sweden' (Interreg Nord 2012). This network of research data facilitated a multifaceted understanding of the interplay between the local community, their fishing practices, and the architectural nuances of the Torne River region. Kukkola is a settlement built on both sides of the river, on the Finnish side and Swedish side, and shows the same urban disposition on both sides. The Swedish side developed several restoration projects and is a linear settlement composed by 18 traditional cultural buildings used today as an open air museum. The primary thoroughfare running parallel to the riverbanks allows for the orientation of each building's immediate access points, of which only two are situated in close proximity to the water, namely the 'Vattenkrafwerk' Hydroelectric power station and the 'Nedre kvarnen' Lower Flour Mill, due to the utilization of the river as a source of energy. A group of 10 huts located south of the village are directly connected with the fishing activity. They include five 'fiskebodar' (fishing huts), the 'Iskällare' (ice house),

Table 1. Summary of the social-architectural aspects.

Geographic	Ethnographic	Architectural
Relation between villages and river flows	Historic fishing activities	Urban composition
Accessibility	Sharing activities related to fish	Outdoor facilities
Distribution along the river		Heritage buildings
		Use of local material

the 'Stekbodan' (grill hut), the 'Kontoret' (the office) and other shared buildings including a fish storage facility ('kalapuohi'), a cooking hut ('paistokota') for both cooking and sleeping, and warehouses for storing equipment. The positioning of the ice house in the centre of the fishing huts highlights the significance of preserving the daily catches, while the grill house and office, situated on the banks of the river for safety and surveillance purposes, are close to the hydroelectric power station and watermill, both of which are no more than ten metres from the water. In the central part of the village appears the Flour Mill, built in 1860, also called the tax-mill because it was a property of the village but state-controlled and a certain amount of grain had to be paid as state tax. The energy provided by the watermill was also used for a sawmill and the wood work was turned into shingle for covering roofs. In more recent times other buildings appeared near the old village, such as the Fish Museum is the upper part of the village where, a restaurant located in the central part, and a new settlement of wooden huts and a hotel in the south (Figure 5).

The lack of private areas surrounding the buildings emphasizes the commitment to fishing activity. The design of the exterior and open spaces is structured to be minimal, with an emphasis on green spaces, and a focus on the connection between buildings rather than purely functional infrastructure. This decision serves to enhance the visibility of fishing activities and provides a space that is conducive to this purpose. The outdoor space image is dominated by the traditional wooden pier called 'Krenkku' in the Torne River which is used to reach the middle of the rapids. The origin of this structure, as documented by U. T. Sirelius at the beginning of the twentieth century, comes from the stationary salmon weirs in Norrbotten called the 'mockapata' which consists of a row of trestles

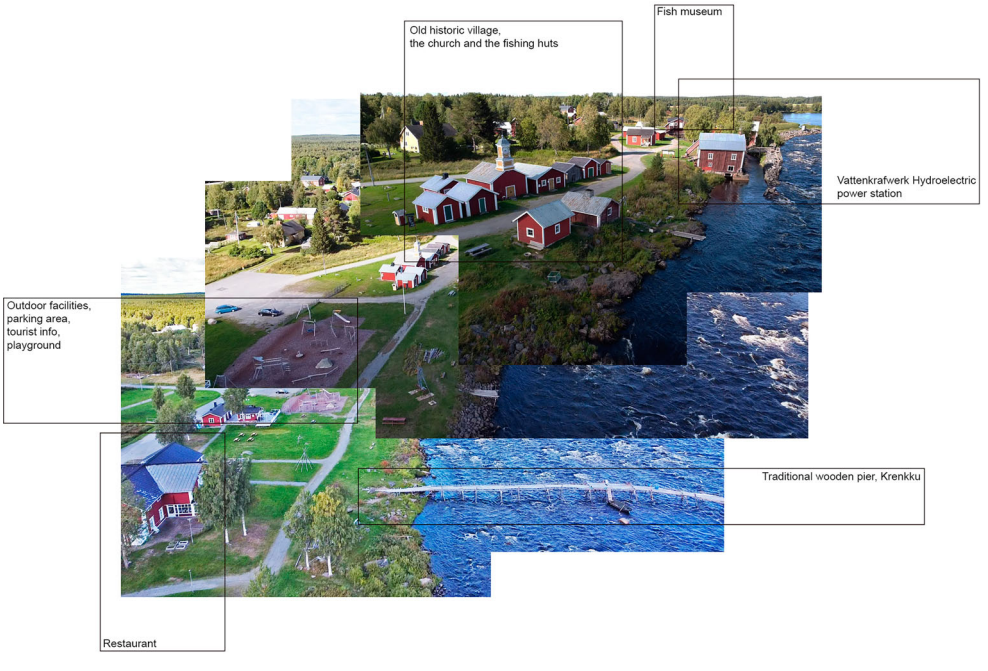

Figure 5. Kukkola village. Graphic by S. Tornieri from drone survey, 20th August 2022.

connected with ridgepoles and laths leaning against them forming a close wall. Even if other types of weirs are known the most impressive ones are the 'Hevos-pata' at Kukkola Village built after the end of the salmon fishing season and the beginning of the whitefish season. This temporary structure is human-buildable and demountable, made from local wood and constructed every fishing season by the old builders. The construction techniques of the dams are entirely natural. It evolves on the terms of nature and reflects the ancient traditions and life of the old primitive peoples. Even if different types of piers are present all of them have functionalist compositions. Every part has its own purpose and is composed of a primary rigid 'A shaped' structure inserted into the water, a double horizontal order of beams, and a walking path made of boards. The force of the water shakes the pier so often that there is a secondary reverse V structure to reinforce the main one (Figure 6). The volume of water and stream flow have influenced the length of the bends or dams they have had to be built. Also the empirical knowledge, developed over centuries by the fishermen, influenced the piers typology according to the conditions and the movements of the fish, which are different in relation to the water currents. In the Korpikylä village, for example the current is strong all the way to the shore and the fish come fairly close to the shore, so there has been little need for long and heavy dams or piers.

The village of Korpikylä has a different urban composition, with the settlement even more minimal than Kukkola (Figure 7). Only three huts are dedicated to fishing activity and are located as close to the water as possible. We find the typical cooking hut well-suited for preparing skewer-roasted whitefish and whitefish soup, and the ice hut storage close to the wooden ramp and stairs is placed on the riverbank for an easy access to the fishing spots. Small interventions into the riparian vegetation of the river are dedicated to fishing activities, such as a conservation ice hut, a fire hut for cooking, small outdoor benches, wooden stairs to reach the water and other facilities. The ice hut is made of pieces of rocks and built underground using a level gap in the riverbank for better conservation of the fish. A group of

Figure 6. The Krenkku, a traditional bridge built every year in Kukkola. Picture composition by S. Tornieri using images from Norrbotten Museum Archive.

Figure 7. Village of Korpikylä, the riverbank facilities and the settlement. Picture composition by S. Tornieri.

wooden stairs near the ice hut connects the upper level to the river water. Due to the strong current in Korpikylä fishermen did not develop the traditional bridge so they used the biggest rocks as a platform. The empiric knowledge developed over centuries allows the fishermen to predict and to guess where the fish normally rest, behind a rock or in a particular round of water, depending on the water level.

Traditional fishing and fish diets have been an important source of income and sustenance for the village communities. 'Porina', or small talk, revolving around fish creates a natural base for social interaction. Social life also includes various old traditions, such as the whitefish festival held at the end of July to celebrate the migration of the fish. Social interaction is important for the wellbeing of village communities, as it helps to create a sense of community and belonging among residents. In the case of traditional fishing villages, the shared experience of fishing and preparing fish dishes can create a strong bond among community members. This can help to develop a sense of unity and solidarity, which can improve the villagers overall well-being. Additionally, social events and traditions, such as the whitefish festival, can provide opportunities for villagers to come together and celebrate their shared culture and history. The rapids field is a community gathering place where local residents come together to discuss daily topics, such as fish and the water level. The area has several historically significant buildings, including the fishers' old storehouses, a cooking hut, and fish storage buildings. These buildings are protected as part of the heritage landscape of the rapids area. According to tradition, fishermen were allowed to select a whitefish for cooking in addition to their usual share of the catch.

4. BGI qualitative assessment model: results

For the evaluation phase, we overlaid the information obtained from the GBI analysis with local preferences, using previous indications from the Interreg project. The GBI model has substantiates the significance of fishing villages in terms of their relationship

with green and blue infrastructure. Additionally, through an on-site survey and analysis of historical maps, the sites have been recognized for their historical importance. At a geographical scale the model showed a predominance of access points to water around the two case studies. Specifically, Kukkola village presents ten instances of connection between public spaces and outdoor facilities with the river, of which seven are privately reserved for registered fishermen and are characterized by traditional wooden piers. Korpikylä has only two private access points. In Karungi area, no equipped access points to water are reported between the two recognized fishing villages. Apart from of the Torne River, other blue infrastructures such as lakes, ponds or smaller water canals are located more than five Kilometres from the village's centres. Hence, they are not primarily considered in a design strategy to improve connections with blue infrastructures. Regarding the green infrastructure the GBI study highlights a clear presence of forests (deciduous and coniferous) widely sprawled into the study area, with scarce hierarchies in terms of connection with the existing roads (Figure 8).

With a more detailed focus on the Kukkola village, the GBI maps have been added to display the functional situation, highlighting the green areas surrounding the historical village. The secondary roads are primarily associated with the parking lot, restaurant, and tourist huts, and do not offer many opportunities for expansion into the nearby forest or further north, closer to the river. This limited accessibility poses challenges to the development and growth of the village, especially in terms of infrastructure and resource utilization. It is essential to explore alternative strategies that can potentially enhance the village's prospects for growth and development while preserving its cultural heritage and natural resources. Taking a more detailed look at Korpikylä village, the GBI maps reveal significant non-green areas, which on-site surveys confirm are private areas with diverse uses. Accessibility to the village is limited, with only one main road and a secondary road providing access. The forested region to the north and the wetlands on the river's border present an opportunity for development.

The analysis of the case studies underlines the substantial significance of ecosystem services, particularly pertaining to provisioning services and their contribution to overall well-being (Figures 9 and 10). Concerning provisioning services proximity to water sources has been known to play a crucial role in the livelihoods of many fishing communities. As mentioned, the abundance of fish is attributed to the constant flow of water of the free-flowing river Torne, which brings in nutrients and supports the growth of different fish species. However, fishing villages are not only limited to fishing activities. The organization system of the farmers in these villages has permitted them to diversify their economic activities, including agriculture and reindeer farming. This diversification allows the communities to have multiple sources of income and reduces their dependence on fishing alone. Additionally, being close to the forest is a significant advantage for fishing communities. The forest provides an abundant source of wood, which is essential for building houses and infrastructure related to fishing activities. As demonstrated, fishing villages use wood to construct temporary bridges, boats, and tools to fish, among other things. The abundance of wood in the forest has significantly reduced the cost of acquiring building materials and infrastructure from other areas.

Regarding well-being services, recognizing of the historical traditions inherent to the area and the cognizance of being situated in a high-value heritage site plays a crucial role

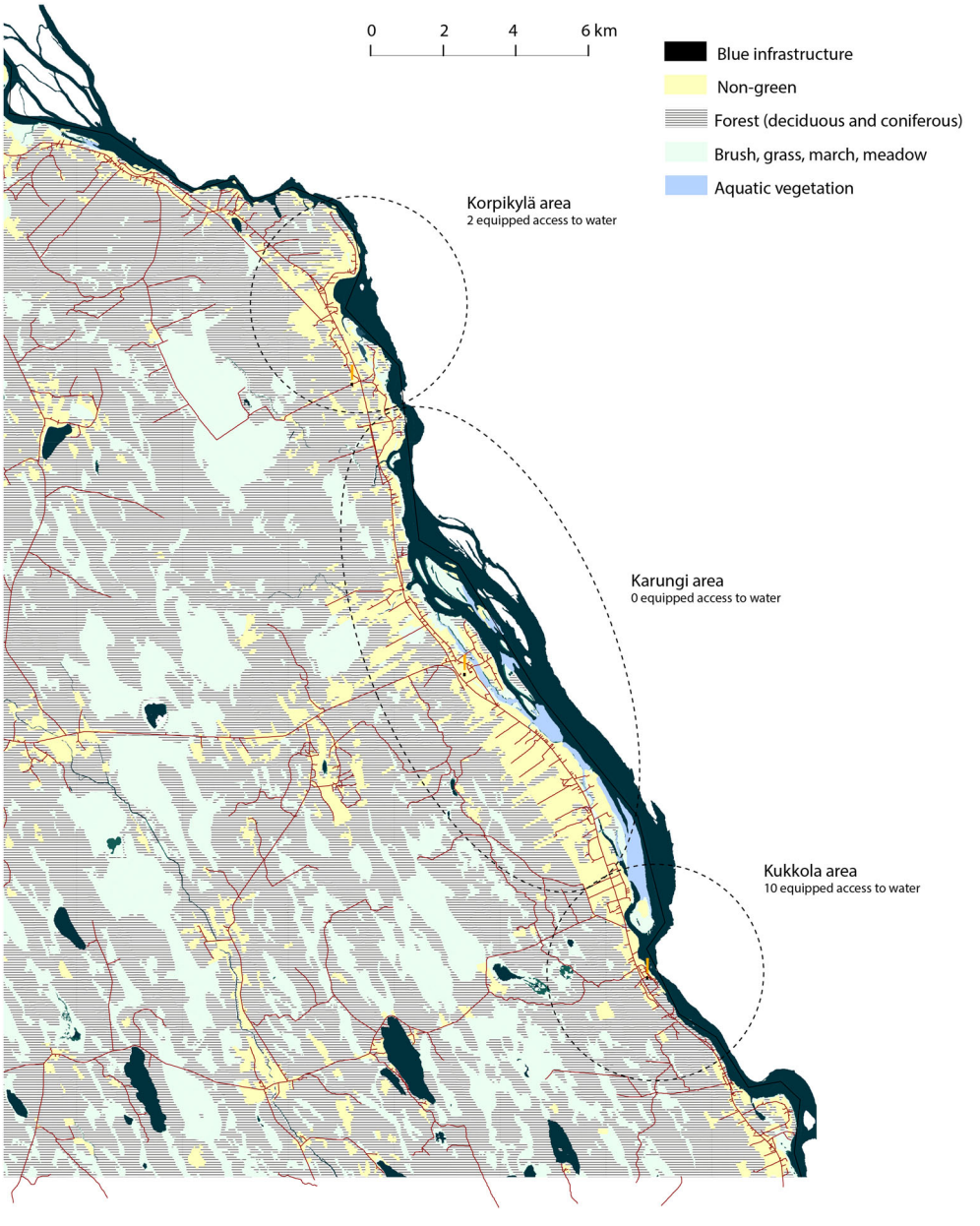

Figure 8. GBI map at a geographical scale, by Jing Ma and Stefano Tornieri.

in perceiving the place's aesthetic value and symbolic essence. Acknowledging these elements fosters a sense of connection and appreciation for the cultural significance and identity of the surroundings, thereby enriching the overall well-being experience. This awareness of the uniqueness and historical context engenders a heightened sense of place attachment, contributing to the individuals' emotional and psychological well-being within the designated area.

Figure 9. GBI map at the village scale, current situation and design proposal for Kukkola. Maps by Jing Ma and Stefano Tornieri.

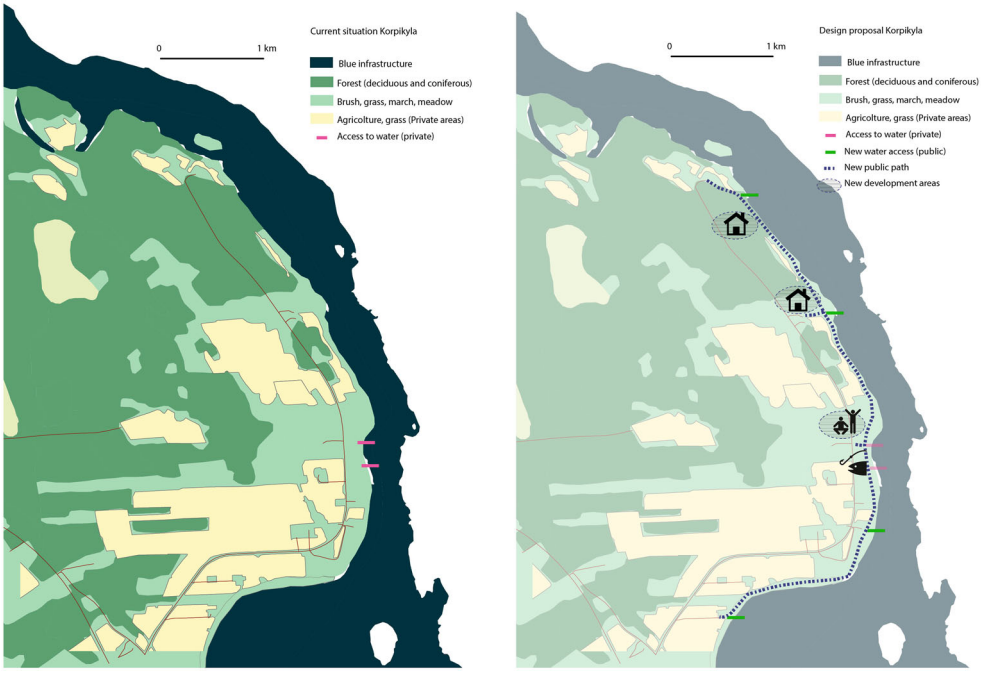

Figure 10. GBI map at the village scale, current situation and design proposal for Korpikylä. Maps by Jing Ma and Stefano Tornieri.

5. Discussions, proposal to promote attractivity

The present article acknowledges the urban and architectural features of fishing villages and their potential to augment their attractiveness via the increasing significance of green and blue infrastructure in supporting ecosystem services. In summary, the analysis unequivocally underscores the potential for sustainable development within traditional fishing villages integrating rural structures and establishing linkages to green and blue infrastructure. Safeguarding the rural qualities and biodiversity cannot be avoided, as they are fundamental prerequisites for the enduring survival of these villages. Moreover, the ecosystem services furnished by fishing communities, encompassing provisioning and well-being services, assume indispensable roles in meeting the needs of the local population. By implementing a series of purposeful design interventions, including creating public spaces, optimizing accessibility to water expanses, and the strategic placement of new activities in close proximity to water sources, the appeal of these places can be amplified. Ultimately, the mix of natural and cultural constituents enriches the overall well-being experience and engenders a profound sense of attachment to these villages.

To improve attractiveness three design actions are recommended:

Recovery: revitalize the city's attractive role by creating new magnets and meeting points. These include the reconversion of a series of disused and inaccessible places such as the mill for Kukkola, which can be transformed in a more active public space, for communicating traditions and as a meeting point for the residents.

Improve accessibility: The analysis demonstrates a scarcity of public connections with the river water. To enhance public access to green spaces adjacent to the river, improving public paths leading to such areas is imperative. Upgrading public pathways can significantly reduce barriers that hinder access to green spaces and increase their visibility, attractiveness, and usability. Furthermore, well-maintained and well-designed public paths can encourage people to engage in physical activity, promote social interaction, and improve overall well-being.

Locate new activities: several areas for future development have been identified in Kukkola village. These areas surround the historical parts of the village, and with improved accessibility, they can accommodate more inhabitants, beyond just tourism. Furthermore, various functions designed appropriately for public use can be located near the water to improve outdoor facilities. Proper planning and design of these facilities can attract more visitors, enhance the village's prospects for growth and development, and improve the quality of life for its residents. For the Korpikylä Village the absence of an urban centre presents an opportunity to allocate new housing developments close to the river while integrating harmoniously within the surrounding forested area. By situating these dwellings near to the existing fishing locales, it becomes feasible to enhance their appeal by expanding fishing activities to wider public participation on select days throughout the year, and alongside the establishment of small public spaces such as playgrounds.

As visible from the maps, the availability of territorial data differs significantly between Sweden and Finland, with the comprehensive and easily accessible data for the Swedish territory and the lack of public data from the Finnish side. Given this disparity, the present study avoids direct comparisons between the two borders. Additional limitations occur due to the scale on land cover data. Not all GBI categories are adequately assessed.

This suggests that integrating different GBI elements allows for a more structured evaluation of the outdoor recreational usage. To address this gap, future research endeavours could focus on augmenting the existing data by incorporating territorial connections with the Finnish border along the river. Expanding the dataset to encompass this crucial aspect can enable, a more comprehensive understanding of the border region, facilitating a more nuanced analysis and comparison between the two countries.

5.1. Applicability of the approach to similar cases

The proposed approach combines quantitative analysis through GIS software and existing data with qualitative research methods like on-site surveys and historical site descriptions. This mixed-methods approach provides a more holistic understanding of the green and blue infrastructure, especially in the context of urban compositional aspects. The focus on urban compositional aspects implies an attention to the aesthetic, functional, and social elements that contribute to the overall structure of the studied areas. This focus could indeed serve as a valuable framework for extending the methodology to similar cases, especially in regions where traditional fishing activities have shaped territories. The mention of extensibility to other cases, especially in Arctic regions, indicates a recognition of the uniqueness of each location and the need for adaptability. The proposed methodology is adaptable and potentially applicable to a range of sites, particularly more capable for small urban scale and those with cultural, historical, and environmental significance tied to traditional activities strongly connected to green areas or water bodies. For instance, another potential case study involves the impact of salmon fishing practices in the Teno River, Norway. Approximately 25% of salmon destined for spawning in the Teno River are intercepted by nets and traps in the Norwegian sea before reaching the river. Interestingly, this interception contributes to a significant portion of the catch for tourist fishers in Finland, highlighting the complex cross-border dynamics of salmon fisheries. Other traditional locations, like the remote lake Paudijärvi, are now accessible for under-ice fishing, or The Gävle area, along the Norrland coast, was the location where the Gävle fishermen held a monarchy-granted monopoly from 1557 to 1776, covering a 2000-kilometer coastline, during which they established fishing villages for their operations.

6. Conclusions

Our starting research question was: which qualities can foster community engagement and increase the overall appeal of these areas in the future? Our analysis shows that the urban composition of the traditional fishing village can provide a strong foundation for the future development of the village, and the integration of traditional rural structures, such as wooden bridges, stairs, small huts and mills. There rural structures that have historically served as connectors between villages and river water presents a promising opportunity to establish sustainable linkages to green and blue infrastructure in contemporary times. This approach can effectively enhance the attractiveness and sustainability of local communities not only the daily presence of tourists, which has presented a new economic opportunity for local communities, allowing them to sell their crafts and products to visitors. However, the sustainability and long-term survival of

these villages depends on their ability to maintain and develop their rural qualities in relation to the green and blue infrastructure. The attractiveness of these villages should be based on their unique rural qualities and the biodiversity and resilience of their biophysical subsystems (Holling and Meffe 1996). By prioritizing the maintenance and development of these qualities, these villages can better promote sustainable tourism and establish a stronger connection with the natural environment. Therefore, local communities should aim to focus on the preservation of their rural qualities, including the maintenance of their traditional structures and the enhancement of their biodiversity, as a means of ensuring the survival and prosperity of their villages in the long-term. The results of the analysis allow us to evaluate the qualities of fishing villages from a different perspective, particularly concerning to the ecosystem services they provide. Therefore, analysis results offer a valuable tool for policymakers and stakeholders to make informed decisions about managing and conserving fishing villages and their surrounding ecosystems. The new emphasis has to rethink the resource management objectives, from an isolated and conventional open-air museum towards objectives that seek to maintain the health and integrity of the social-ecological system as a whole.

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