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Social Exclusion in the Development of Photovoltaics: The Perspective of Fishers in the HU Township

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Abstract

This article critically examines the consequences of the application of a photovoltaic (PV) project on the social exclusion of local fishers, through an environmental justice lens. The project was undertaken to develop a mechanism to increase local government revenue while mitigating climate change. However, the findings reveal that the entry of the PV industry displaced traditional fishery production, causing damage to the livelihood of local fishers and encroaching on their living space. At the same time, the authorities did not pay special attention to the interests of fishers in the distribution of PV revenue. These findings draw attention to the need to address the social exclusion of fishers and take decisive steps to institutionalize more structured and transparent co-creation processes to ensure that the voices of marginalized groups are heard and effectively considered in the process. The research this article draws on is qualitative, comprised of data gathered through document analysis, as well as in-depth interviews with the fishers, representatives of the local government, and the PV companies.

Keywords

environment justice; fishers' livelihood; industrial expansion; photovoltaics; social exclusion

1. Introduction

Since the 75th United Nations General Assembly committed to reaching carbon neutrality by 2060 and peak carbon emissions before 2030, China has made the photovoltaic (PV) industry a key element of its energy strategy. PV technology expansion brings various benefits, such as lower electricity and system costs, reduced carbon dioxide emissions, decreased water usage, improved renewable energy integration, and increased

storage capacity (Cole et al., 2018). Especially in sun-rich nations, the spread of PV projects aids sustainable development goals by boosting the economy and reducing emissions (Han et al., 2020). Driven by national policies and financial incentives such as benchmark electricity price subsidies, the PV industry has seen rapid growth in China's affluent eastern provinces. Despite land scarcity and dense populations, the abundant water bodies in these regions offer ideal opportunities for PV systems. These efficient and eco-friendly systems allow arable land to be preserved and receive active promotion from government policies.

Although the PV industry's growth includes some public participation, it perpetuates China's government-led environmental governance, which frequently overlooks the concerns of local communities. Despite their environmental and economic benefits, these initiatives can cause social disruption. The rise of the PV industry has led to the substantial social marginalization of fishers, encroaching on aquatic ecosystems and jeopardizing their livelihoods and lifestyles. This article broadly defines "fishers" to include anyone involved in fishing or aquaculture in lake areas, be they full-time professionals or part-time workers.

This study, grounded in qualitative research, investigates the phenomenon of social exclusion experienced by local fishers following the implementation of the Hu Township PV project. Covering 29.3 square kilometers, waters in Hu Township were chosen for the "fishery-solar complementarity" project (total capacity: 500,000 kilowatts) following the establishment of the Hong County National Leading Photovoltaic Power Generation Application Base in late 2017. The Hu Township government banned aquaculture in these waters to facilitate the PV project and mitigate ecological damage from intensive and disorganized aquaculture. The government reclaimed the fishers' previously free water resource usage rights and removed fish cages and other aquaculture facilities from the lake. By early 2018, around 1,245.02 hectares of water surface rights had been reclaimed, with about 214.80 hectares allocated for the PV and fisheries project.

Having paid the government a water area rental fee of 7500 yuan per hectare per year, PV companies acquired the rights to use the water surface to install PV panels for electricity generation. Additionally, the PV companies rented a few fish ponds near the lake from village committees at the same rate to install PV panels. Upon receiving local government approval, PV companies invested in and constructed the project, delegating design and construction to scientific research institutions. The PV enterprises managed electricity generation and operations, settling electricity fees with the State Grid Corporation. Aquaculture companies acquired the rights to use and manage the water under the panels for breeding fish such as silver carp, retaining all profits. The PV enterprises' presence generated significant tax revenue for the local government, which offered tax concessions to the PV enterprises to foster development, creating a "win-win" situation. Furthermore, under government advocacy, enterprises allocated part of their revenue to a PV development fund, mainly supporting local welfare initiatives. However, this part of the fund was given to the government for distribution and did not directly benefit the local populace (see Figure 1). Overall, the fishing community was neglected in the decision-making and profit distribution associated with the PV industry's entry. Consequently, due to the loss of their primary source of income and homes without proper compensation, the regional fishing community encountered substantial socioeconomic difficulties.

This research comprehensively examines social inclusivity issues associated with the PV industry's entry into Hu District. We recognize the PV industry's positive impact on local economies and the environment, driven by local governments and enterprises amidst efforts to combat climate change and energy crises. Conversely, we critically analyze the conflict between the PV industry and the livelihoods and living spaces of fishers in

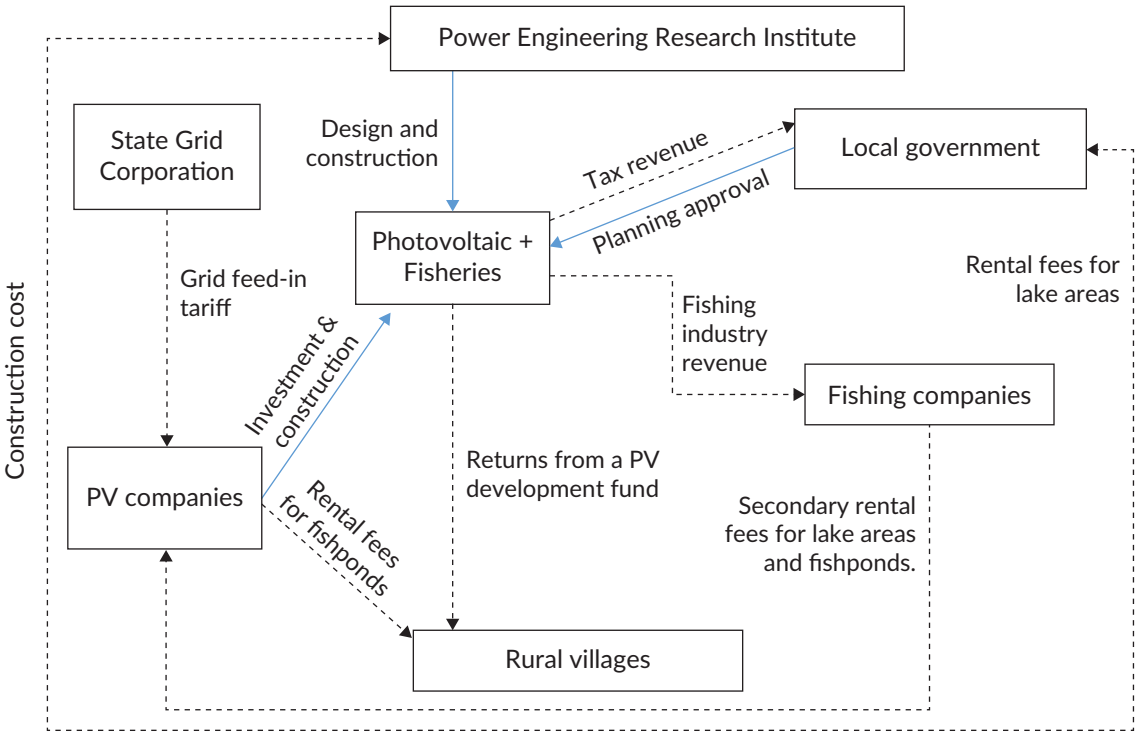

Figure 1. Fishery-PV complementary project operation mode.

Hu District's climate governance with caution. The article begins by introducing environmental justice, exploring how fishers disproportionately endure the negative impacts of strategies against climate change. Subsequently, it analyzes social exclusion scenarios, including fishers being deprived of their livelihoods and overlooked regarding the distribution of benefits. Finally, we examine the impact of the fishers' exclusion from living spaces in their lives and communities. This research aims to deepen understanding of the social impacts of industrial substitution in the fishing sector and sheds light on the experiences of fishers in Hu Township, highlighting the need to address social exclusion in rural industrialization.

2. Theoretical Background

Environmental justice and social exclusion are closely linked and extensively analyzed in scholarly literature. Environmental justice calls for equal distribution of environmental privileges and responsibilities, regardless of race, ethnicity, socioeconomic status, or gender (Pulido, 2000). This academically explored principle addresses concerns such as access to clean air, water, green spaces, and the uneven risk of environmental dangers to marginalized groups (Perlin et al., 1999). Advocates and researchers push for eradicating environmental disparities and integrating social justice in environmental decisions (Egert, 2023), including addressing unequal environmental damage and involving impacted communities in policymaking (Habuda, 2019). Environmental justice seeks to address and rectify these inequalities through activism, advocacy, research, and legislation.

This research identifies two primary dimensions of environmental justice. Firstly, access to environmental resources is critical. Urban growth strains landscapes and can degrade environmental quality. Considering the disproportionate effects of land-use changes on specific communities, understanding their

environmental justice repercussions is crucial. Studies highlight the link between access to urban green spaces and environmental justice (Bauer, 2023; Jennings et al., 2012). Moreover, there are contradictions between large-scale spatial change and community-scale social justice (da Silva & Correia, 2022; Goh, 2020). For example, PV projects have transformed HU Lake's landscape, altering the functionality of its wetlands and restricting local access, contradicting principles of environmental justice.

Secondly, environmental justice aims to correct the uneven distribution of environmental benefits and burdens, advocating for everyone's access to a healthy, sustainable environment. Many factors, including historical precedents of unfair policies and intersectional factors such as gender and race, contribute to environmental injustice (Bell, 2016; Egert, 2023). The movement has evolved from grassroots beginnings to include equitable climate change adaptation strategies (Schlosberg & Collins, 2014). Local energy initiatives have been linked to a range of advantages for the community, including enhanced social cohesion, economic prosperity, the acquisition of new skills, and heightened environmental awareness. In this study, while PV projects have restructured local energy use, reducing coal reliance and aiding climate mitigation, they have encroached on the fishers' livelihoods. Climate mitigation benefits are enjoyed globally, yet fishers bear the negative impacts alone, without fair compensation. This implies that the success of a local renewable energy project should be evaluated based on the local population's perceptions and the project's initial ambitions (Tsagkari et al., 2022).

3. Methods

This study used qualitative research methods to understand the fishers' experiences and perspectives deeply. Qualitative research, offering in-depth comprehension and interpretation from participants' perspectives, is uniquely advantageous in uncovering the fishers' social exclusion issues. Data collection included in-depth interviews and document analysis. In-depth interviews enabled one-on-one interactions with the fishers, yielding rich personal experiences and insights. In-depth interviews were held with diverse HU Township stakeholders, including government officials, leaders of PV and fishery companies, community leaders, and retired fishers, providing corroborating information. Interviews with local government officials involved three key figures from Lake Township's Rural Work Bureau, the Fishery Management Committee, and the Industrial Bureau, and five staff members overseeing the PV industry, fish farming, and fishers. Interviews also included management from two major PV companies, TW and GDT, and a fish farming company, WT. Community leaders and fishers were key interviewees. Investigations were carried out in three rural areas with dense populations of fishers. We interviewed three community leaders, six village officials, and 18 retired fishers, ensuring diverse perspectives across ages, genders, and economic backgrounds. We created semi-structured interview outlines tailored to the interviewees' social characteristics, each lasting two hours.

Document analysis and in-depth interviews serve as triangulation, employing various methodologies to study the issue. We reviewed local statistical yearbooks and literature to grasp the history of fisheries development and fishery culture. Additionally, we analyzed policy documents on fisheries and PV industries issued by the local government to understand its industrial orientation. This analysis will explore how fisheries' industrialization, an exogenous development, impacts fishers' social life. The study aims to highlight the challenges fishers face, including resource access, changes in community dynamics, and the loss of traditional practices.

4. Overlooked in Profit Distribution

In modern legal and property rights frameworks, property rights are fundamental to establishing relationships between entities. Legally, HU's water resources are state-owned, and the state holds the water rights. However, fishers, relying on traditional livelihoods and cultural heritage, possess legally recognized water surface usage rights. During the transfer of the rights, 661 net-cage aquaculture fishers, the original water users, seemingly vanished without being provided rental fees or government compensation. This raises questions about the fairness of establishing property rights, sparking debates over conflict and coordination between fishers' usage rights and state ownership, which will be further explored in a traditional context.

Property rights and boundary practices emerge from state interventions and community actions in resource competition, evolving into local customs. Historically, there has been a shift from communal to private ownership. Traditionally, fishers collectively owned or used water surfaces, gradually establishing fishing boundaries. These boundaries, reflecting lake spatial differentiation, encompass historical fishing practices, including specific rights to fishing locations, boats, tools, and fish types. The Kunshan fishing village study shows diverse fishers catching different fish with varied tools, leading to autonomous livelihood distinctions and a "shared water without centralized control" state (A. J. Chen, 2023).

By the early 20th century, increased external commerce and fish trade demand resulted in private ownership of water areas. Lake area property rights, unlike land, are complicated by human mobility on water, seasonal water level changes, and seasonal ambiguity of water surface rights, making boundary demarcation challenging. Consequently, cultural and official texts often reference a "lack of hard boundaries." However, rights allocation boundaries emerged in lake areas, with rivers divided by settlements and fishers marking "contracting areas" using natural signifiers that are respected in daily practice (Sugawara, 2020). However, such boundaries are not definitive due to the high costs of defining property rights (Bazel, 2017), leaving many rights public, such as aquatic crop cultivation and water activities.

Recent market economy influences have resulted in disorganized water area privatizations. After the 1983 implementation of the household responsibility system, village collective agricultural land and ponds were distributed to individual households. However, there was no consensus on the usage rights of public areas such as a lake's surface. HU District's population ranges from 20,000 to 30,000. On average, each person has 0.05 hectares of land and each household has 0.13–0.20 hectares. The scarcity of land resources forces residents to depend on natural aquatic resources for livelihood. Locals without ownership rights traditionally have usage rights to public lake areas, sustaining their livelihoods through fishing and aquaculture. These rights are legally recognized and protected. Continuing the tradition of public water surface use, local production activities included fishing and aquatic plant cultivation. Village elders recall that, in 1988, some farmers experimented with netting lake portions for intensive fish farming, yielding significant profits. Dozens of nearby households followed, claiming water areas for intensive aquaculture. Legally, public areas such as these water bodies, state-owned, should not be privately owned; however, government management and oversight were lax. In the market-driven development's early stages, the government was equally eager to profit as the locals. Water surfaces alone do not generate income; however, local authorities welcomed renting them out to locals for production activities and collecting part of the rent. The local government and community agreed to rent the lake surface to villagers at 750 yuan per hectare. However, in

practice, this policy was not fully implemented, and some villagers occupied and used the water surface for aquaculture without payment:

> Water surface contracting is basically first-come, first-served. During the trial phase, most villagers were watchful, with only a few proactive ones taking contracts. Once others saw the profits, they wanted in, but there were no more water surface quotas, and they couldn't complain. After all, the opportunities were equal; some people just seized them first. (Retired fisherman Wang)

> It's about capability. I only contracted 0.33 hectare because I couldn't manage more, leaving the rest for others. Some capable ones contracted three to five hectares. (Retired fisherman Li)

Around 2000, local crab farming surged in popularity, with 200 hectares of coastal water densely packed with cages at its peak. Motivated by profits, some farmers expanded into water surfaces for large-scale farming. The government, typically hands-off in water rights allocation, intervened to mediate disputes. Unregulated and seeking quick profits, some engaged in intensive aquaculture, causing environmental issues such as eutrophication. This "tragedy of the commons" prompted government regulation, including licensing. However, environmental issues from widespread intensive farming persisted. Driven by profit and lack of oversight, disorderly farming practices led to severe local environmental pollution, impacting waterway traffic and flood control.

As previously noted, traditional livelihood regulations define rights in fishery resource utilization. However, delineating spatial boundaries is crucial for establishing property rights. The longstanding framework, where the state owns water bodies, but local fishers have spatial usage rights, represents a delicate balance between governance and traditional livelihoods. This arrangement acknowledges the state's role in managing natural resources and recognizes the fishers' reliance on these waters for sustenance and cultural identity. Although unregulated practices among fishers have led to environmental concerns, addressing these issues should ideally involve targeted interventions, education, and sustainable fishing alternatives rather than revoking usage rights outright. Problematic production behaviors, while concerning, do not justify directly depriving fishers of their rights, especially without viable alternatives or compensation.

Currently, neither the government nor enterprise provides economic compensation or aid for water area acquisitions, offering only about 13,500 yuan per hectare for fencing removal. Fishers forced to give up water areas believe the compensation does not cover their property losses or secure their future livelihoods. The government's average total output from water area PV conversions greatly exceeds the average household compensation, making the fishers' sense of relative deprivation palpable. Legally, enterprises must pay government fees for the resources they use, reflecting the transactional aspect of their commercial activities. From a spatial perspective, introducing PV enterprises has effectively nullified fishers' production activities, depriving them of their traditional livelihoods. If not managed inclusively, this transition risks marginalizing fishers, eroding community structures, and worsening socio-economic disparities.

From a social inclusivity and justice standpoint, offering adequate livelihood compensation to affected fishers or integrating them into emerging PV production activities is crucial. Considering the compatibility of aquaculture operations with PV installations, as seen in PV-aquaculture systems, involving original fishing communities in these ventures is compelling. Including fishers would secure their livelihoods and utilize their

expertise in aquatic management, potentially improving the productivity and sustainability of aquaculture operations under PV panels. Allowing fishers to participate in PV-aquaculture systems could create communal ownership and involvement, easing transitions and enhancing social harmony. Although beneficial for renewable energy, the shift to PV enterprises should be approached with empathy, fairness, and a commitment to social inclusivity. Integrating fishers into PV-aquaculture systems or offering suitable compensation is a balanced approach, respecting tradition and embracing progress.

5. Fishers' Lives and Social Exclusion

5.1. The Social Exclusion of Fishers' Livelihoods

In history, the economy of the HU Lake area was primarily based on the exploitation of water resources, encompassing fishing and aquaculture, known as "living off the water." Before the entry of the PV industry, each fisherman typically had access to a specific water surface area, averaging about 2.5 hectares, which was not just a source of livelihood but also a testament to their ancestral ties and cultural heritage. There was a competitive demand for limited water resources, resulting in the encroachment on the livelihood resources of fishers and posing a threat to their livelihoods.

Fishers in the HU Lake township could be divided into two main types. One type is the legally recognized professional fishers with fishing-related household registrations. Professional fishers are restricted to certain water areas for fishing or aquaculture activities and do not have land onshore. Fisheries are their sole source of livelihood. The other type is part-time fishers, referring to ordinary onshore farmers who engage in agriculture and aquaculture or work outside while also participating part-time in aquaculture and fishing activities in the water. For them, fisheries are important but not their sole source of income. Considering the extent of the impact of the fishing cessation program on fishers' livelihoods, the government has implemented targeted support measures and comprehensive compensation for professional fishers during the process of fishing cessation, including assisting them in continuing fisheries-related activities locally or in neighboring provinces or cities, providing entrepreneurship loans, and offering social security funds. However, professional fishers only account for 1% of all fishers—the majority are part-time. When PV enterprises entered the expropriated water areas, the government only provided non-targeted measures, such as an average compensation of 13500 yuan per hectare for fence removal, without specific measures for employment assistance or social security for these part-time fishers. Overall, the policies and systems are not sufficiently refined, and effective support and protection measures have not been provided for part-time fishers. Hence, the concept of livelihood presented in this article is mainly focused on these part-time fishers.

In the local context, aquaculture operates on a household basis. As of 2017, when the government mandated the cessation of aquaculture, 633 households were still engaged in these activities. A distinct generational divide characterizes these practitioners: While individuals over 50 tended to stay and engage in aquaculture, the younger generation, aged 20–49, often sought higher-paying jobs elsewhere. This divergence is not merely a matter of choice but reflects broader socio-economic shifts.

The reform and opening-up policies, coupled with over four decades of rural-urban migration, have profoundly altered China's employment landscape, pushing an increasing number of rural residents into

non-agricultural sectors (Gustafsson & Zhang, 2022). The regional economic disparities create "cores" of resource concentration, attracting investment, population, and technology, while less prosperous areas become "peripheries," experiencing outflows of these same resources and a consequent "hollowing-out" effect (Li, 2023). Hong County, situated in northern Jiangsu, exemplifies this periphery. Economic vitality has long been low, especially in its southwestern hilly region, with nearly 60% of villages classified as economically weak and a significant portion of the population earning a meager annual net income. To circumvent these constraints, laborers have historically migrated to southern Jiangsu's more prosperous locales, such as Suzhou, Wuxi, and Changzhou, seeking better employment opportunities.

Thus, the impact of industrial transition is most acutely felt among the over-50 demographic of the 633 aquaculture households. In the academic sphere, different perspectives exist regarding the impact of resource loss on farmers' livelihoods. For instance, in the discussion of the impact of enclosure movements on displaced farmers, traditional views represented by the Hammond couple argue that enclosures led to the loss of land for farmers, exacerbating poverty and inequality in rural areas (T. Chen et al., 2022). On the other hand, some scholars believe that enclosures provided new development opportunities and additional employment opportunities for displaced farmers. However, a generally accepted viewpoint is that due to changes in the external environment and livelihood capital after the displacement of fishers, their original livelihood activities became difficult to sustain, forcing them to choose new livelihood strategies. Overall, the post-displacement livelihood strategies of fishers exhibit a trend toward non-agricultural diversification and multifaceted development (Zhang et al., 2012). A critical socio-economic issue is the exclusion of local fishers from the burgeoning PV industry due to technological and managerial thresholds they cannot easily surmount. This exclusion underscores a broader, systemic problem often witnessed in periods of rapid industrial transition.

The displaced fishers face difficulties in acquiring new skills when seeking re-employment. Fishers's vocational skills are primarily concentrated in the field of fisheries. Traditionally reliant on aquaculture, fishers have honed skills and knowledge tailored to their trade over generations. Their expertise, while invaluable within the context of aquaculture, does not readily transfer to industries such as the technologically advanced PV sector. This industry, with its emphasis on technological acumen, specialized knowledge, and often higher educational requirements, presents barriers that most fishers find insurmountable, primarily due to their limited formal education and lack of exposure to relevant technical training. Moreover, the PV industry's management practices and operational scale necessitate a form of corporate governance and bureaucracy alien to traditional, small-scale, family-run fishing operations. Consequently, these fishers find themselves in a precarious position. Their traditional livelihoods are undercut by the new industry, yet they cannot participate in the very sector that's replacing their traditional jobs. This dilemma forces them to seek employment elsewhere, often in sectors or positions that do not recognize or compensate for the depth of their experience in aquaculture, leading to underemployment or even unemployment. Rural women with lower levels of education, in particular, are in a disadvantaged position when it comes to choosing employment opportunities, thereby putting their basic livelihoods at risk. At the same time, retired or displaced fishers with better skills also face various degrees of restriction, discrimination, and exclusion when migrating to urban areas. Most of the agricultural transfer population can only engage in temporary and migratory movements between rural and urban areas, lacking stable employment locations. This can result in significant psychological pressure:

> We fishers are the poorest. Most of us in this generation are illiterate and have never received formal education. Without education, it becomes difficult to find employment. Nowadays, the only option for us is to do labor-intensive work in factories. (Retired fisherman Ma)

> It's difficult for illiterate women to find jobs in factories. We are already in our forties and fifties, so we can only stay home and care for our children. Occasionally, we can find temporary work nearby. (Retired fisherman Gu)

From a social inclusion perspective, the ideal scenario would be for the PV industry to absorb this workforce, capitalizing on their intimate knowledge of the local aquatic environment and providing them with roles that, while different from their traditional work, offer continuity in terms of income and social identity. However, the older fishers in the HU District, typically over 50 years of age, face two primary forms of exclusion, each with its own set of socio-economic implications.

On the one hand, they suffer exclusion from the PV industry. The entry of the PV industry not only brings a company and an industrial chain to the local area but also objectively provides employment opportunities for the local population. Some residents have been absorbed into the PV industry. Despite offering employment opportunities and training, the PV sector inherently demands a workforce that meets specific criteria, including age, physical robustness, learning agility, and technical expertise in electricity-related areas. These requirements create a barrier for older fishers, whose lifelong skills and expertise lie predominantly in traditional fishing practices, not high-tech industries. This mismatch in skill sets, coupled with the physical demands of the new jobs, effectively excludes these seasoned fishers from the emerging job market within the PV industry.

On the other hand, the fishers are excluded from "aquaculture under the panels," a characteristic of fishery-PV complementary projects. The water area under the PV panels can be utilized by enterprises with usage rights for ecological aquaculture. The innovative approach of integrating aquaculture with PV panels (known as the fishery-PV complementary model) should, in theory, provide a seamless transition for displaced fishers. This model allows for ecological aquaculture practices under the PV panels, an area that seems naturally suited to the skills and experience of the local fishers. However, in practice, this is not the case. Concerns over management costs, operational control, and the safety of PV equipment lead enterprises to favor formally trained internal employees over local fishers. Even when these companies engage local help, it is often for menial, short-term tasks, offering little in terms of sustainable income or job security. Take TW PV company as an example; they only hire local part-time workers for labor-intensive tasks such as releasing fish fry and fishing, with a daily average of 10 person-days over 20 days, resulting in limited employment opportunities.

While policies often neglect the re-employment support for fishers, this oversight occurs within complex temporal and spatial contexts. Even before the 2017 retirement policy, young and middle-aged laborers frequently sought work beyond their hometowns. This trend has led to a distinct intergenerational shift in fishing households' production structures. Older couples typically engage in local aquaculture, whereas their younger counterparts pursue diverse employment opportunities elsewhere. Consequently, most fishing families maintain a diversified income portfolio, enhancing their per capita earnings and reducing their reliance on fishing. Local governments and policymakers often view this labor migration trend as a natural transition towards non-resource-dependent livelihoods, requiring no intentional guidance. Recognizing that

fishing households are not monolithically dependent on aquaculture is crucial. Many of these families have diversified income sources, which can be a form of resilience. Policies should, therefore, avoid one-size-fits-all solutions and instead consider the varied economic landscapes of these communities. This laissez-faire approach overlooks the small, often unnoticed community of fishers, encompassing merely 633 households, resulting in insufficient public concern and support for their development. Addressing this issue demands policies informed by social justice, focusing beyond economic considerations to acknowledge the social and generational complexities of communities facing industrial and environmental change. Effective strategies may encompass retraining and new skills for older individuals, comprehensive social security measures, and promoting unique cultural and natural legacies to forge sustainable livelihoods.

5.2. The Social Exclusion of Fishers' Living Space

Living spaces are essential to fishers' livelihoods and well-being. This study examines the impact of fishers' exclusion from their living spaces on their lives and communities.

Fishers' habitats are more than residences; they are deeply intertwined with their economic and cultural well-being. Urban sprawl and industrial advancement threaten these traditional spaces, often reducing resource access and causing involuntary community displacement. Traditionally, fishing communities are located near water surfaces and tidal flats near lakes. PV developments invade traditional fishing territories, reduce resource availability, and displace communities, undermining socio-economic stability. The rise of PV enterprises forces relocation, leading to community depletion, marked by the absence of the younger generation who leave the elderly and children behind. Compounding these challenges is inadequate social security and inefficient fishing cooperatives.

Furthermore, the industrial repurposing of environmental assets such as lakes and wetlands erodes natural habitats and reduces the quality of living space. Beyond functionality, these water bodies contribute to scenic beauty, offering recreational and tourism potential (Wu et al., 2019). Their aesthetic value enhances visual appeal and fosters a connection with nature (Rava et al., 2015; Wu et al., 2019). In traditional rural societies, landscape aesthetic appreciation is seen as natural ecological beauty. The landscape of PV panels, a modern industry product, clashes with the traditional ecological landscape, and the introduction of PV enterprises has altered local natural vistas, unsettling residents. Field interviews with locals reveal deep-seated discontent; many see the once-pristine scenery as "destroyed." Numerous adverse claims have been made, including observations of fish deformities in the lake and reduced rainfall patterns after PV panel installation. One interviewee, a lifelong resident, lamented:

> After the photovoltaic panels arrived, we noticed the fish in our lake started looking different, not like before, and it just doesn't rain as it used to. (Village group leader Hu)

While these assertions await scientific confirmation, they underscore the residents' substantial resistance to the perceived environmental repercussions of PVs.

Besides, for local fishers, natural water bodies are not just ecological spaces; they serve as versatile social arenas for various uses. Apart from livelihood activities, these aquatic environments are crucial for leisure, acting as communal hubs for swimming and other recreational activities. However, the PV industry's entry into

areas like Tian Gang Lake has limited these waters' use to a single purpose. PV and aquaculture companies have erected barriers at the water's edge, restricting access to formerly communal spaces. This monopolization has squeezed locals' living and leisure spaces, confining their activities to village dwellings and land. The project development process has overlooked the water bodies' natural expansiveness, which provided relaxation and served as travel thoroughfares. This oversight highlights the need for an inclusive approach that considers the ecological and social dimensions of industrial expansion. Interviews with local villagers reveal that their opinions were not effectively considered during the project approval and construction phases. This revelation underscores a key principle: incorporating local input into decision-making enhances project adaptability and acceptance and fosters initiative sustainability and success. Residents have a deep understanding of their environment and community needs. Their insights can help project planners avoid issues and leverage the community's unique strengths. Ensuring locals have a voice in critical decision-making is essential for achieving project objectives and promoting community well-being.

Last but not least, the cultural significance of water bodies is profound. However, with the industrialization of these spaces, a growing disconnect emerges, leading to the gradual erosion of water-centric cultural practices. In traditional fishing livelihoods, locals naturally revere water bodies, and the worship of water deities is integral to their activities. This cultural detachment highlights the need for a nuanced development approach that considers the socio-cultural dimensions of affected communities. Policies that advocate for inclusive development, respect for indigenous knowledge, and sustainable alternative livelihoods are essential. These initiatives could mitigate displacement's adverse effects, enhance community resilience, and preserve the rich cultural tapestry of fishing communities.

6. Conclusion

This article explores the social exclusion of fishers in Hu Township due to PV construction on water surfaces. The qualitative research method has given us a comprehensive understanding of the complex and far-reaching impacts of social exclusion from the fishers' perspective. Through data collection and analysis, we have uncovered significant findings and themes.

Firstly, the evident disregard for resource allocation stands out. Historically, fishers' right to use natural water surfaces was recognized, but the requisition for PV development has deprived them of this vital livelihood source. While they received some compensation for livelihood tools and property rights, they were denied water area rents and other economic compensation. Ignoring their deep psychological attachment to this natural resource has intensified their sense of deprivation.

Secondly, industrial substitution has led to significant livelihood exclusion for Hu Township's fishers. The entry of PV enterprises has occupied water spaces used for fishing, causing the loss of traditional fishing activities and societal marginalization. Most fishers, with low education and limited skills outside fishing, face restricted non-fishing employment options. Particularly, older fishers and rural women with limited education face job market disadvantages, causing instability and financial difficulties.

Furthermore, industrial substitution's social exclusion has destructively impacted fishers' living spaces and cultural heritage. The water served as both their livelihood and living space. Repurposing environmental resources such as lake surfaces and wetlands for industry has led to the loss of natural areas, affecting the

quality of their living space. Industrial substitution has disrupted Hu Township's deeply rooted fishing traditions and gradually distanced fishers from their close-knit communities.

This study's findings illuminate the social exclusion experienced by Hu Township's fishers due to PV development. Government industrial decisions are often conceived and implemented from a regional perspective, prioritizing overall interests and departmental policies. However, the survival methods of special occupational groups such as fishers and the resources they rely on are often overlooked. Recognizing fishers' unique spatial needs and promoting social justice in spatial planning and policymaking is crucial to addressing their exclusion from their living space. This necessitates establishing an organizational mechanism and effective policy system for coordination and communication at all levels.

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Conflict of Interests

The authors declare no conflict of interests.

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