EXPLORING LOCAL SPATIAL ORGANIZATION OF OFFSHORE WIND ENERGY AND COASTAL FISHERY: INSIGHTS FOR JUSTICE FROM CHANGHUA, TAIWAN (1137)

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Abstract. The justice issue in energy transition concerns its distribution of benefits and burdens to society and environment. Space has been acknowledged as the underlying factor of distributive justices, by exploring the location and the relationships constituted by space. This study constructs a conceptual framework that can be used for analysing the relationship between capability of fishery livelihood, spatial organisation and justice. Through a case study of coastal fisheries and offshore wind farm development in Changhua, functionings of a coastal fisherman are defined as fishing behavior, mobility of fishing boats, accessing to fishing grounds. The capability set as their choice is constituted by fishing hours, fish catch and fishing methods for target species.

Keywords: capability, spatial organisation, coastal fishery, offshore wind energy

1. Introduction

Justice plays an important role in sustainable transition that address many environmental issues. The normative thinking of justice is to promote a more equable and inclusive participation between marginal actors and powerful actors in the development process (Köhler et al., 2019). Therefore, in terms of the justice of energy transition worldwide, it is crucial to consider the disparities related to distribution of benefits and burden among social groups in the systemic transformation process. Moreover, justice can help people to identify neglected issues from a moral aspect during the implementation of a radical transformation for purposes.

The “space” is considered as significant dimension to identify the disparities of social condition and injustice of energy transition (Bouzarovski and Simcock, 2017; Fathoni and Setyowati, 2022). Some scholars dissect broad effects of the low-carbon energy system on local territories and social spaces to clarify adverse and beneficial externalities from the practice of energy transition (Barnacle, 2020; Bosch and Schmidt, 2020). Space not only functions as a container to locate technical-industries for energy transition, delivering goods and services to people, but also as a medium to discuss the relationship between material and social, political activities. In light of this, analysing in the relations of spaces, social groups and associated changes is ready to illustrate injustice

phenomenon in such a transition process.

In recent years, Taiwan's large-scale offshore wind farm projects expand rapidly on sea and coastal area owing to the transformation policy to de-carbonization and net zero emissions. Fishermen contend that the construction of offshore wind farms not only close traditional fishing grounds, but also exclude fishing from certain sea area. At the same time, they cast doubt on potential impacts of offshore facilities on the marine ecosystem, habitats and environment as well (Chen et al., 2015; Zhang et al., 2017). Although Taiwanese fishermen were opposed to these projects, but many of them compromised after obtaining fishery compensation. It is possible that the change of spatial organisation resulted from offshore wind farms have a profound influence on fishermen's status of livelihood. However, most of the debates end up with the ocean grabbing of offshore wind farms and fisheries exclusion in the previous studies. How do fishermen in their day-to-day fishery operations and quality of livelihood are changed by the deployment of the offshore wind farms is not sufficiently manifested.

Therefore, this study attempted to construct a conceptual framework that can be used for analysing the relationship between capability of fishery livelihood, spatial organisation and justice. The following section explores the notion of capability approach with its implication of justice, and notes the role of space in the analysis. In the third and fourth section, a case study of Changhua is presented as the empirical evidence for constructing the conceptual framework. In the final section demonstrates further direction for the follow-up study.

2. Building conceptual framework: Capability approach, justice and space

2.1 Capability approach and justice

The capability approach is acknowledged to justify justice on the basis of people's capabilities to obtain well-being and quality of life (Israel and Frenkel, 2018; Przybylinski, 2022). If the relationships between human and their capability is reduced in space and time, it may be comparative injustice, in a manner of speaking (Ballet, Koffi and Pelenc, 2013). In Amartya Sen's pioneered work on capability approach, the capabilities of a person constitute one's advantage to realize various functions of living as a compound of doings and beings (Sen, 1993). Therefore, Sen argues that the evaluation of "well-being achievement" and "well-being freedom" is significantly associated with "functionings", "capability set" and "choices". As far as the freedom of choices and achieved functionings are concerned, researchers can analyse one's capability set for assessing particular well-being. "Functionings" are a combination of actions and state of existing that a person exercises on account of well-being achievement. The notion of "capability set" refers to a person's alternative functionings. The range of "choice", in other words

of freedom, is how a person values the components that he or she can choose in corresponding capability. In fact, capability approach is a framework of thought to evaluate normative issues (Robeyns, 2000). Namely, the evaluative space of capability approach must be identified clearly by the specification of value-objects and its potential scope while make the judgement of the relationship between a person's capability and justice.

2.2 Interaction of capabilities and spatiality

The capability perspective can have fertile insights into spatial intelligibility of justice. Although what is the capability approach highlight in analysis seems to focus on agency aspect, actually, the view of capability would concern itself further with social structures and environmental factors that together influence a person's or a social group' capability set to converse goods and services (Robeyns, 2005) (see Figure). In the previous studies, Israel and Frenkel (2018) draw on capital forms, habitus and their relationship of spatial substance to characterize the constitution of "capability set" and their functions in the field, in order to examine how people could mobilize different sets of goods for life-chances and well-beings. For further application of the theoretical framework, they identify the spatial dimension of the living environment as a concept to influence the capabilities-building of people through the (intermediary) social space which incorporate economic capital, cultural capital and social capital (Israel and Frenkel, 2020). Taking a better grasp of empirical spatial inquiries and practices into consideration, justice thereby implies keeping people's particular capabilities for living that depends on the creation of relational condition of capabilities and living environments where people involved (Basta, 2016).

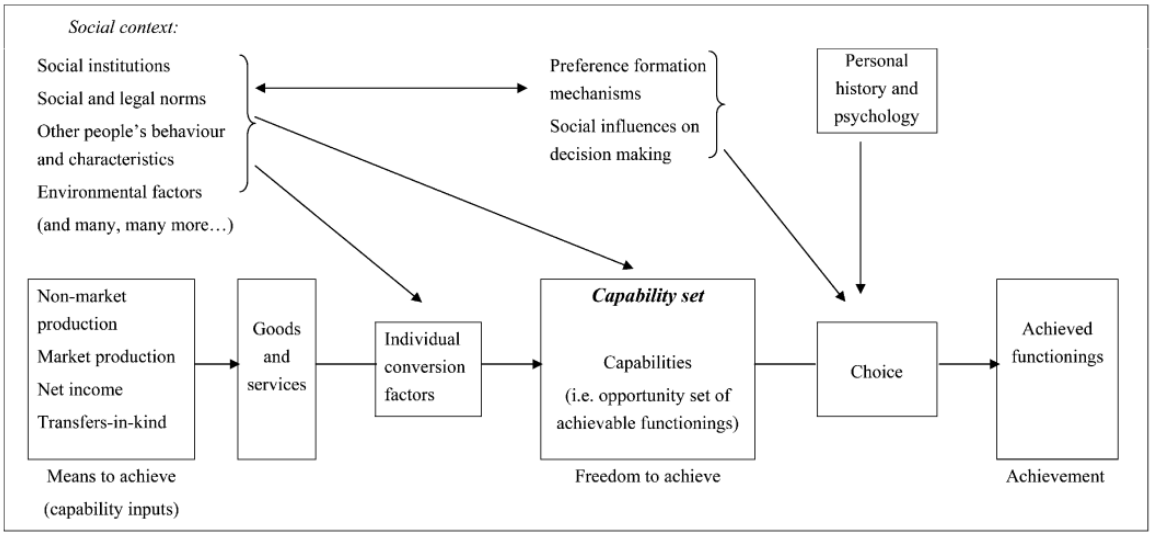

Figure 1. A schematic representation of a person's capability set and her social and personal context

Source: Robeyns, 2005, p. 98.

3. Methodology

The case study is conducted in Changhua where 11 offshore wind farms are planned up to 4.47 GW of capacity before 2026 and become the densest developing sea area, thus dominating the offshore wind farm site for Taiwan (see Table 18). At present, the offshore wind projects in Changhua area have a turbine capacity in the range of 5.2~9.5 MW. Taipower offshore wind farm - phase 1 demonstration project has been in operation since 2021. Three offshore wind farm projects are scheduled to be completed in 2023. In the face of sequential construction and maintenance activities of offshore wind farms, the spatial re-arrangement has to be performed to keep the overall marine activities operational.

Table 18. Offshore wind farms in Changhua (Developed by 2026)

Scheduled completion year	Project	Capacity (MW)	Numbers of turbines (unit capacity)	Status
2020 (completed in 2021)	Taipower offshore wind farm - phase 1 demonstration	109.2	21 (5.2 MW)	In operation
2023	Changfang offshore wind farm	541.5	57 (9.5 MW)	Under construction
2023	Greater Changhua 1-	600	75 (8 MW)	Under

Scheduled completion year	Project	Capacity (MW)	Numbers of turbines (unit capacity)	Status
	South East offshore wind farm			construction
2023	Greater Changhua 2a-South West offshore wind farm	288	36 (8 MW)	Under construction
2024	Xidao offshore wind farm	47.5	5 (9.5 MW)	Under construction
2024	ZhongNeng offshore wind farm	294.5	31 (9.5 MW)	Under construction
2025	Taipower offshore wind farm - phase 2	294.5	31 (9.5 MW)	Consent authorized
2025	Greater Changhua 2b-South West offshore wind farm	337.1	N/A	Consent authorized
2025	Greater Changhua 4-North West offshore wind farm	582.9	N/A	Consent authorized
2025	Hai Long 2A offshore wind farm	300	N/A	Consent authorized
2026	Hai Long 2B offshore wind farm	232	N/A	Consent authorized
2026	Hai Long 3 offshore wind farm	512	N/A	Consent authorized
2026	Haixia offshore wind farm	300	N/A	Early planning

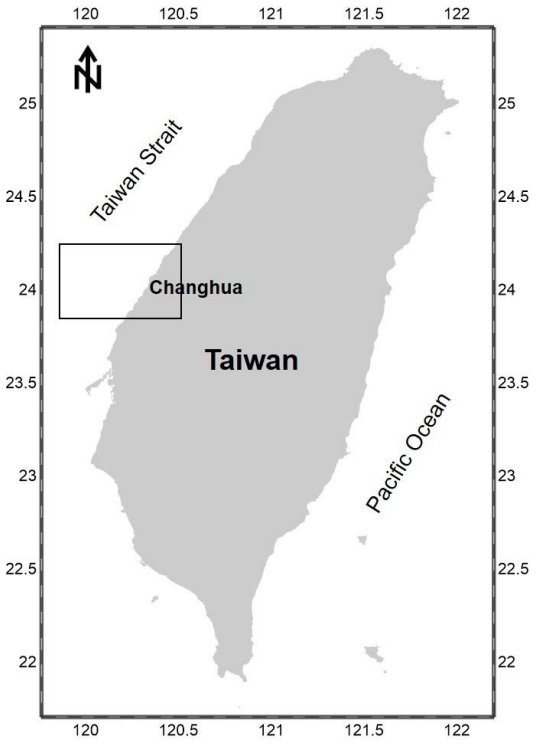

Figure 2. Map of the study area

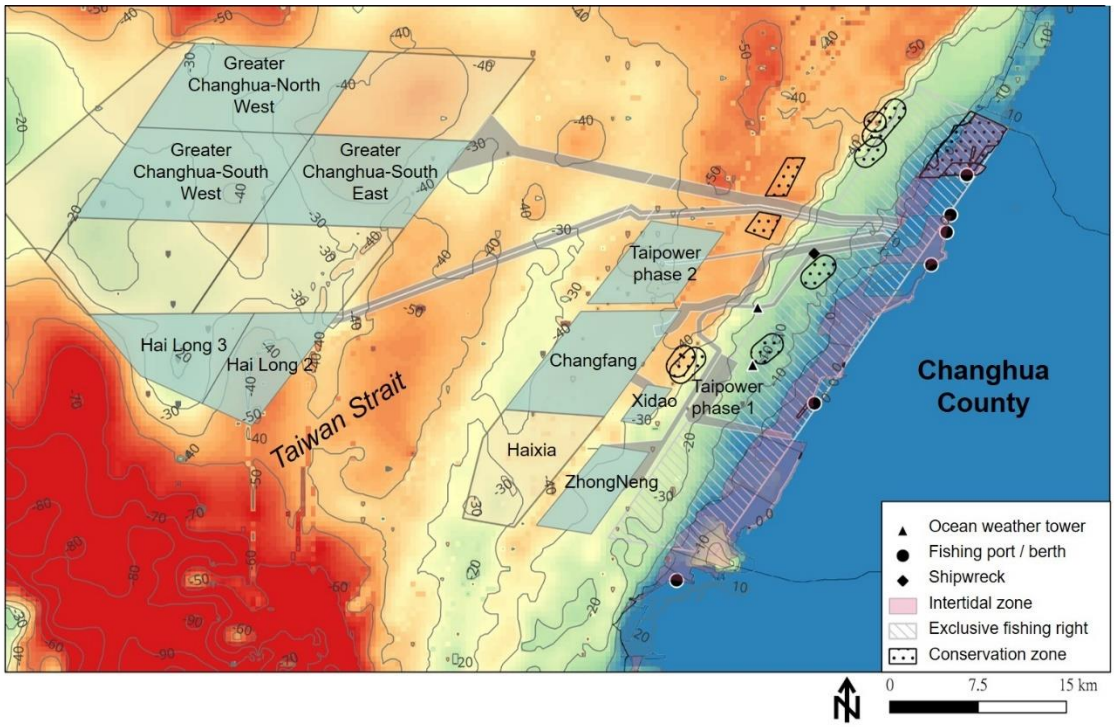

Figure 361. The spatial organisation of offshore wind farms in Changhua

Field works was carried out from 2019 to 2022 and data was collected through semi-structured interviews, observation, field notes, offshore wind project documentation, including government reports, environmental impact statements, and public news. In order to understand the diversity of coastal fisheries and their reactions about the progress of offshore wind farms in Changhua, around 82 interviews of Changhua coastal fishery community have been carried out so far, which include professional fishery operators and sideline fishery operators. The interviews are transcribed with recording-consent from the research participants. Short follow-up investigations and field notes had been made when current issues emerged in the field. The information had also been preliminarily inquired and clarified through different viewpoints from offshore wind developers (local liaisons), fishermen's association and responsible authorities.

Table 19. List of interviewees in Changhua coastal fishery community

Fishery port / berth	**Career types**	**Fishing methods / gears**	**Numbers of interviewees**
Wang-Gong fishing port	professional fishery operators	Gill nets	10
		Angling, Traps and Pots, Gill nets	1
	sideline fishery operators	Gill nets	8
		Gill nets, Angling	3
		Angling	2
Xucuogang fishing port (Yunlin)	professional fishery operators	Gill nets	1
Baxian berth	professional fishery operators	Gill nets	1
		Gill nets, Traps and Pots	5
		Gill nets, Angling	1
		Angling, Traps and Pots, Gill nets	2
		Recreational fishing boat	1
	sideline fishery operators	Gill nets	1
		Gill nets, Traps and Pots	2
Kunlun berth	professional fishery operators	Gill nets	1
		Gill nets, Angling	1
	sideline fishery operators	Gill nets, Angling	1
Lunweiwan fishing port	professional fishery operators	Gill nets	8
		Gill nets, Traps and Pots, Angling	1

Fishery port / berth	Career types	Fishing methods / gears	Numbers of interviewees
		Gill nets, Angling	1
		Gill nets, Traps and Pots	1
		Angling	1
		Recreational fishing boat	4
	sideline fishery operators	Gill nets	2
		Angling	6
Wenzai berth	professional fishery operators	Trawlers	13
		Gill nets	1
	sideline fishery operators	Trawlers	2
		Gill nets	1

4. Results

4.1 Functionings and capability set of a fisherman for coastal fisheries in Changhua

The functionings and capability set of a fisherman are possible to illustrated according to the understanding of coastal fisheries operations. To begin with, functionings are associated with what fishermen do for fishing on the sea. Elements of fishing activity comprise regular fishing behavior of casting / hauling fishing gears which require enough space and time.

For over decades, the major types of small-scale fisheries for livelihood are gillnets fishery and small-medium trawling fishery in Changhua coastal areas. Despite the catches of gillnets and trawling are relatively high, some fishermen are used to having a combination of angling or the gears of traps and pots as the supplementary fisheries to support households (see Table 20). Major fishing methods are introduced as follows. Gillnets fishery operation depends on tide and wind by fluid water in order to catch target species. In this way, fishing boats drift parallel to the coast and moves for 8 to 16 kilometres with 1 kilometre long nets. In order to waiting for the fish, adequate mobility and spatial extents are needed in the routine operation of gillnets. Small-medium trawling fishery including bottom trawls and midwater trawls, in contrast, does not depend on the current to operate. In general, they fish along the same water depth relying on the driving of engine power. Consequently, both gillnets fishery and trawling fishery temporarily occupy the three-dimensional sea space and fish resources during the act of fishing and movements.

Second, the need of fishing boats for mobility and access to a known and potential fishing grounds is also essential because of the fluid fish resources and vessel maneuver.

Migratory fish is the main target species for marine catches in Changhua coastal area. Changes of fishing grounds is accompanied by the arrival of seasonal migratory fish and seasonal mature benthic species, e.g., crabs and Areola babylons. For the experienced gillnets fishermen, they identified their seasonal fishing grounds in relation to different depth of water and water temperatures. For instance, cuttlefish is catch with water depths at 20 to 30 metres in spring and summer. Mullet is catch with water depths at 10 to 20 metres or 28 to 40 metres in winter. In addition, a bottom trawling fishermen pointed out that he was trawling from the north to the south with water depths at 20 metres, and returning from the south to the north with water depths at about 40 metres. Both of the gillnets and trawling use highly mobile fishing boats to move and fishing.

Third, capability set are associated with the conversion of fishery harvesting and sustain livelihood. The way of economic conversion can be grasped through a combination of fishing hours, fish catch and fishing methods for target species. A fisherman is able to choose one or a few fishing methods from gillnets, trawling, angling and traps and pots. Different fishing methods are corresponded to various of target species, cumulative hours and the amount of fish catch by the time. This reflects the alternatives that can be transformed into the livelihood achievement.

Table 20. A combination of fishing methods in Changhua coastal fisheries

Major fishing methods	**Supplementary fishing methods**
Gillnets	Angling, Traps and pots
Trawling (bottom trawling, midwater trawling)	Gillnets, Angling, Traps and pots

4.2 The spatial organisation of coastal fisheries in Changhua

4.2.1 Legal fishing area established by regulations

In Taiwan, some regulations are formulated to restrain people from fishing in specific areas. For examples, trawling is forbidden to fish within 3 nautical miles where is the spawning grounds of many species. It is because trawling usually fish a great deal of non-selective of undersized species by small mesh. Additionally, only angling is allowed to fish in the artificial reef and fishery resource protected zone.

4.2.2 The concept of fishing grounds: formation and the locations

A fisherman said that," *Fish is not distributed evenly across the ocean, so that fishing grounds are the places where amount of fish is*". In light of this recognition inspired, the concept of fishing grounds is likely to be distinguished into two levels which are related to the feature of marine ecosystem and the capability of individual fisherman. At the first level, fishing grounds formation is generated from the ecological relationships between the life cycle of specific species and habitat. At the second level, fishing

grounds is of individual's habitual fishing areas or traditional fishing areas where a fisherman is able to reach. In some ways, where different coastal fisheries take place in locations are thereby derive from fishermen's cognition of marine fishery environment and their own fishing practices. For example, small artisanal boats of gillnets usually fish by waves on the shore where is the feeding grounds of fish. Medium artisanal boats of gillnets usually change operational locations as fish move further from the shore.

4.2.3 Natural environment and infrastructure

Besides fishing methods, the possible spatial distribution of coastal fisheries can be illustrated observing from the environment and boat sizes. Due to a vast intertidal zone and a lack of deep-water ports in Changhua coastal areas, fishing boats have to access and leave the fishing ports or berths according to semidiurnal tide times per day. So, fishing operations are fitting for a limited time which is within 12 or 24 hours. Moreover, the weight of artisanal boats or small-scale vessels are often less than 5 tons, and no more than 50 tons. In respect of wave resistance, most of the fishing boats, except for trawls are limited to oceanic condition and wave scale that difficultly operate a far distance from shore in a terrible day.

4.3 Construction of a conceptual framework

Based on the notion of capability approach and on the spatial organisation which affects a fisherman's functionings and capability set, this study construct a conceptual framework (see Figure) to examine the spatial relationship of coastal fisheries under the construction of offshore wind farms in Changhua. As the first step, functionings of a coastal fisherman are defined as fishing behavior, mobility of fishing boats, accessing to fishing grounds. The capability set as their choice is constituted by fishing hours, fish catch and fishing methods for target species. These are important doings for fishermen to sustain a livelihood. The second step tells what kinds of spaces would make a great difference to fishermen's functionings. This identifies the spatio-temporal characteristics between fishing activities, physical environment, spatial-related regulations and fishing grounds in order to indicate the standard of normal fishing operations. In the end, this study recognizes the relationships between spatial organisation, functionings and capability set in structuring the conceptual framework for analysing possible changes of livelihood.

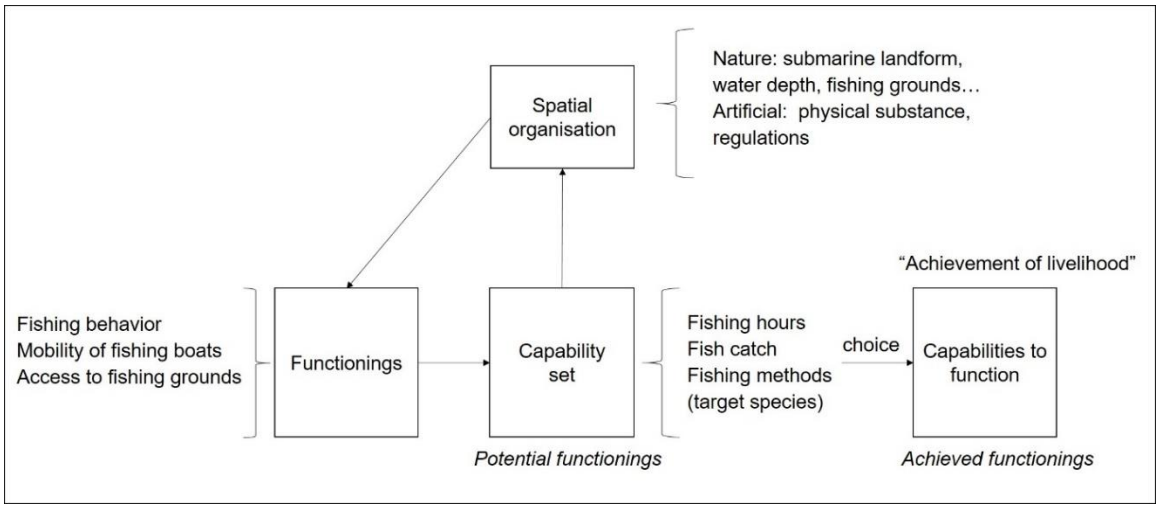

Figure 4. A conceptual framework of a fisherman's capability set in the effect of spatial context

5. Conclusion

This study demonstrates that spatial organisation plays a role to influence each element of functionings and lead to the status of capability set through a case study in Changhua. An offshore wind farm is consisting of wind turbines, subsea cables including inter array cables and export cables, a substation on land, and (or) an offshore substation. Changes in spatial organization brought by offshore wind farms have particular affect the capability of coastal fishery. The follow-up study is hoping to use the conceptual framework established in this study to analyse the specific spatial impact of offshore wind farm on fishery livelihoods.

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