Social-ecological systems analysis of the dried fish value chain for community wellbeing in the Bay of Bengal coast of Odisha and West Bengal, India

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Statement of contributions

I am the sole author for Chapters One and Five which were written under the supervision of Prateep Kumar Nayak. Chapter Two, Three and Four are developed as co-authored manuscripts for publication. I am the lead author of those chapters. Chapter Two was co-authored with Prateep Kumar Nayak and Derek Armitage. Chapter Three was co-authored with Prateep Kumar Nayak and C. Emdad Haque and is submitted to Coasts, a MDPI journal for publication. Chapter Four is currently under preparation for journal submission. Bibliographic citations for the chapters are given below.

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Chapter IV

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Abstract

Small-scale fisheries (SSF) support over 90 percent of the 120 million people engaged in fisheries globally. Dried fish is an important sub-sector of SSF, which is characterized by the declining social, economic, and political conditions of people involved in its production and the ecosystems they depend on. The term "dried fish" is defined by the Food and Agricultural Organization (FAO) as products that are cured, salted, preserved in brine, and/or smoked. Dried fish accounts for 12% of the total fish consumption globally but can increase up to 36% in low-income countries. About half of the people involved in dried fish production and marketing are women. The production and trade of dried fish are important sources of livelihoods, employment, food, and nutritional security for poor people engaged in the dried fish value chain. Despite the importance of the dried fish sector, there is a gap in relevant literature that can provide a comprehensive view of the sector involving economic, social, and ecological perspectives, and their dynamic interactions.

The approach taken to analyze the dried fish sector has so far followed a narrow subset of commodity chain approaches with a focus on financial value, transmitted in a linear, vertical fashion across value chain actors. The existing value chain approach fails to factor in the non-capital relationships of dried fish that are contingent upon specific histories, ecologies, peoples, places, and practices. The narrow neoclassical economic perspective of the dried fish value chain (DFVC) also impedes appropriate responses to its unique attributes pertaining to social, ecological, and institutional interactions across multiple scales. Failure to consider the social-ecological system (SES), its connections, and relationships with the dried fish value chain not only undermines the social wellbeing of upstream actors but can also perpetuate social-environmental inequity and injustice.

This research addresses this gap by reconceptualizing the dried fish value chain with due recognition of non-linear and dynamic connections of people, ecosystems, and value chains using a SES lens. The research was framed with three objectives: (1) to map the social-ecological attributes of the dried fish value chain (feedback, linkages, uncertainty, and emergence) at the production and processing nodes; (2) to empirically study how fishers and dried fish workers (upstream actors) see the dried fish value chain in relation to SES attributes and indicators; and (3) to analyse how SES-oriented value chains help unpack "value" as the social-ecological well-being of people and ecosystems.

These objectives were examined using an interdisciplinary conceptual framework. The framework considered fisheries resources an important and influential node in the value chain structure. The analysis across dried value chain segments helped to identify the criticality of different chain segments and key considerations within each segment. There are three critical theoretical areas that contributed to framing this research, including value chains, social-ecological systems, and the social and ecological wellbeing of fishers and dried fish workers. A systematic scoping review of the literature resulted in the development of a novel social-ecological system oriented dried fish value chain (SESDFVC) framework (objective 1). The second and third objectives are achieved through an empirical investigation using a multilocation case study approach and a mixed method research framework in northern Odisha and eastern West Bengal on the Bay of Bengal coast.

Here, the SES lens offers an empirical basis to appreciate resources as a critical node in the dried fish value chain and broaden the understanding of 'value' as the social-ecological wellbeing of actors in the dried fish value chain. Further, the research advances the scholarship on value chains in general and the dried fish value chain in particular by developing a novel analytical framework. The framework provides for novel outlooks on structure, conduct, and performance that have greater alignment with the inclusive pro-poor value chain approach. The departure of thinking from profit and market logic to systems logic that involves social, economic, and ecological interactions provides a comprehensive understanding of place based and actor-based issues in a disaggregated manner. It is responsive to local conditions and provides equal access to natural resources, rights, responsibilities, and cost-effective technologies for efficient usage. SESDFVC, with a focus on building understanding of non-linear feedback, dynamic linkages, uncertainties, and emergences as system attributes, is better placed to address the concern of breaking trade barriers for the poor to participate in the value chain as key contributors.

Key words: Dried fish, Value-chain structure, Value-chain conduct, value-chain performance, SES attributes, social-ecological well

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List of Abbreviations

CAGR:	Cumulative annual growth rate
DFM:	Dried Fish Matters – a Canadian-based research partnership focused on dried fish social economies of South and Southeast Asia
DFVC:	Dried fish value chain
EEZ:	Exclusive Economic
FAO:	Food and Agriculture Organization
FISHFED:	Fisheries cooperative federation of Odisha state
GoO:	Government of Odisha
GoI:	Government of India
SSF:	Small-scale Fisheries
SES:	Social-ecological systems
SEWB:	Social-ecological Wellbeing
SESDFVC:	SES oriented dried fish value chain
RA:	Research Assistant
SCOPUS:	A bibliographic database containing meta data and abstracts of academic journal articles
SDG:	Sustainable Development Goals of the United Nations
SSF Guidelines:	Voluntary Guidelines in Securing Sustainable Small-scale Fisheries in the context of food security and poverty eradication
V2V:	Vulnerability to Viability Global Partnership
WTO:	World Trade Organisation

Chapter I

Introduction

1.1. Research context and problem rationale

Dried fish has long been an integral part of the oriental food systems, social-cultural systems, and the regional fish trades across the world (Marcus, 1987; Ruddle & Ishige, 2010.). The present research adopts the Food and Agriculture Organization's (FAO) definition of cured fish as dried fish including dried, salted, in-brine, and smoked fish (FAO, 2015). Dried fish accounts for 12% of the total fish consumption globally (FAO, 2018), but it is significantly larger in low-income countries. About half of the people involved in dried fish operations are women. India is the second largest fish producer in the world with a total production of 14.16 million tons in 2019–20, out of which 26.31% was from marine fisheries. The production of dried fish is higher than average in the maritime eastern Indian states of Odisha and West Bengal. In Odisha, 6.32% of the total fish catch is used for drying, compared to 6% in West Bengal. However, 15% of the marine fish catch is made up of dried fish in Odisha. (GoI, 2020)

Rich in calcium and other micronutrients, dried fish is an important source of food and nutrition in both coastal and mountainous regions (Belton & Thilsted, 2014). FAO, in the "Voluntary guidelines for securing sustainable small-scale fisheries", also considers fish processing as an important driver of food security and poverty reduction (FAO, 2015). Dried fish is an important sub-sector of small-scale fisheries (SSF), which experiences similar marginalizing trends in the social, economic, and political conditions of the people involved in its production, and the ecosystems they depend on. Self-employed enterprises and small-scale operators dominate the dried fish operations in South Asia. People from marginalised groups, including women, widows, children, religious minorities, and lower caste communities, make up the labour force for dried fish operations. They are highly vulnerable to disasters, various forms of exploitation, and health risks (Belton et al., 2019; Deb & Haque, 2017). Further, the trade-focus and increasing capitalisation of commercial fishing have posed serious challenges to the dried fish economy and ecology, including the livelihoods of dried fish processors, petty traders, and poor workers engaged in the sector (Dey & WorldFish Center, 2008).

Dried fish as a subsector of small-scale fisheries has received little academic and policy attention despite its significant contributions to the nutritional and social-ecological wellbeing of the poor (Belton et al., 2022; Thilsted et al., 2014). The academic attention has been on the food science aspect of dried fish. The literature underrates a comprehensive look of the value chain, culture, social relationships, and ecology of the dried fish industry (Belton et al., 2022; Funge-Smith, et al., 2005). The dried fish sector often overlaps with artisanal fishery. The low value and trash fish use are facing multiple threats from these trade practices. These threats include increased demand for fish meal and animal food, extractive fishing (with use of gill nets and bag nets); reducing fish stocks of preferred dried fish varieties, non-tariff barriers (ecolabels, quality standards, and certification); and a low capacity to comply with sanitary and phytosanitary standards associated with food products (Béné, 2009; WTO, 2017).

In addition, the imposition of standards and opportunities for business diversification, pushes the dried fish sector is towards greater adjusted vertical integration and capitalization. Consequently, the poor fishers are left out of mainstream operations. Adjusted vertical integration provides for value chain operation where one actor dominates the chain. In most cases, they are the investors who operate at the lower end of the distribution value stream. Increasingly, fish processing factories are operating with their own vessels and controlling other downstream activities like transportation, product distribution, marketing, and exports (Béné, 2009). Furthermore, current public policies and investments are focused on maximizing productivity and income-generating potential. However, there is little consideration about the sector's potential contribution to diets, nutrition (food systems), health, women empowerment, political empowerment, and sustainability (Ahmed & Lorica, 2002; Thilsted et al., 2014). Such a dominant policy paradigm and the small-scale fishers' lack of structuring (including dried fish workers) have perpetuated the problem of political marginalisation (WTO, 2017), exacerbating an already highly unequal relationship between fishers and trade companies (Béné, 2009). Through time, trade practices have evolved and used the value chain as an instrument to alleviate poverty and address marginalization. (Altenburg, 2007; Minh & Osei-Amponsah, 2021).

Value chain analysis is preferred over other trade theories in explaining why the poor may face barriers to trade (Mitchell et al., 2009). A fish value chain is defined as a set of interlinked value-adding activities that convert inputs into outputs, which, in turn, add to the bottom line and help to create competitive advantage for the business (De Silva, 2011). FAO technical guidelines for

responsible fishing have put stronger emphasis on value chain development of fish processing, trade, and poor-friendly market systems for enhanced economic efficiency and welfare gains in developing countries (Webster & Collins, 2005, p. 54). In this conventional commodity value chain approach, value is perceived from a neoclassical economic understanding of value as financial gain (Belton et al., 2022; Pradhan et al., 2022). Value chain performance is assessed at a firm and sector level by mapping financial gains across different segments together. Such economic discourse of value undermines the intrinsic value of the commodity; rather, it focuses on the marginal utility derived from the exchange of commodities across nodes and segments of a value chain. It ignores the processes and relationships that determine the production of a commodity (Fabinyi et al., 2018a; Ferguson et al., 2022).

Interdisciplinary scholars have contested the neo-classical economic perspective on natural resource commodities (Fabinyi et al., 2018; Johnson, 2017; Nayak & Berkes, 2011). Products like dried fish that are embedded in particular social, political, cultural, and geographic contexts. They cannot be considered in isolation from the social and resource relationships (Adger, 2006; Jentoft, 2000). In fact, fisheries social-ecological systems (SES) call for an analysis that is accommodative of complex human and environment system interactions and problems (Berkes, 2003; Nayak & Berkes, 2011).

Fisheries value chains receiving strong pressure to achieve financial objectives fail to factor in the essential characteristics of the product with regard to its non-capital relations although they are contingent upon specific histories, ecologies, peoples, places, and the practices therein (Fabinyi et al., 2018a; Failler & Pan, 2007; Ruddle & Ishige, 2010). Furthermore, dried fish value chain policy and investment lack perspectives about the nutritional value and food system of dried fish(Ahmed & Lorica, 2002). This further complicates the identification of appropriate responses to their unique attributes pertaining to complex social, ecological, and institutional interactions across multiple scales (Ericksen, 2008; Marshall, 2015). The narrow perspective of "value" justifies the sectoral challenges to the dried fish sector emanating from increased demand for fish meal and animal food, extractive fishing (with use of gill nets and bag nets), reducing stocks of preferred dried fish varieties, non-tariff barriers (ecolabels, quality standards, and certification), and the low capacity of fishers and small scale processors to comply with sanitary and phytosanitary standards associated with food products (Béné, 2009; WTO, 2017).

Given the multidimensional, complex, and highly dynamic nature of the dried fish subsector, significant knowledge gaps are found in terms of the value chain's ability to address the social, cultural, and ecological concerns across the value stream (Altenburg, 2007; Mitchell et al., 2009). This calls for novel approaches that can help develop a more inclusive and holistic understanding of value chains, with specific reference to dried fish. Situating the research in a dried fish context in the Bay of Bengal region of Odisha and West Bengal, India, this dissertation aims to strengthen the conceptual understanding of the dried fish value chain with a greater appreciation of social-ecological system attributes. Secondly, the dissertation aims to build a novel perspective of "value" as the "social-ecological wellbeing" of value chain actors by recognising the diverse ways value is generated, particularly for fishers and dried fish processors.

1.2. Research purpose, objectives, and key contributions

The purpose of the dissertation is to examine the dried fish value chain and expression of value from a social-ecological system perspective. The research is based on the case studies of dried fish value chain in eastern Indian coast of Bay of Bengal, involving two communities and associated value chain actors in Odisha and West Bengal states of India. Within this empirical context, the following objectives guide my research:

- To map the social-ecological attributes of the dried fish value chain (feedback, linkages, uncertainty, emergence) at the production and processing nodes. (Chapter II)
- To empirically examine how fishers and dried fish workers (upstream actors) contribute to the dried fish value chain in relation to SES attributes and indicators. (Chapter III)
- To analyse how the SES-oriented value chain contributes, unpack the "value" as the social-ecological wellbeing of small-scale fishers and dried fish producers. (Chapter IV)

These objectives were examined using an interdisciplinary conceptual framework. The framework considered resource dynamics as an important and influential node in the value chain structure. The analysis highlighted critical elements and key considerations within each dried fish value chain segment. Three critical theoretical areas that contributed to framing this research are: value chains; social-ecological systems and the aspects of connections and relationships with subsystems; and the social and ecological wellbeing of fishers and dried fish workers. A systematic scoping review of the literature resulted in the development of a novel social-ecological system oriented dried fish value chain (SESDFVC) framework (objective 1). The

second and third objectives were achieved through an empirical investigation using a multilocation case study approach in northern Odisha and the eastern West Bengal coast of the Bay of Bengal with a focus on upper segment value chain actors. The results of the first objective guided the empirical research on SESDFVC (objective 2) and contributed to broadening the definition of “value” as "social-ecological wellbeing" of fishers and dried fish processors (objective 3). The results of the research are structured under three objectives as mentioned above and are presented as three independent yet related, manuscripts written for academic publications (Chapters II to IV). Each manuscript discusses the theoretical foundation, research methodology, findings, and analysis of the specific research question guided by each of the research objectives, and their implications for improving our understanding of the dried fish value chain and the “values” in dried fish chain.

1.3. Areas of Literature

My research integrates three main areas of enquiries in accordance with my objectives. First, to develop an understanding of the dried fish value chain from a social-ecological system (SES) perspective, as it provides a novel framework for analysing various attributes, value chain connections and interactions. Such attributes and connections have stronger implications for the contextual reality of upstream actors, including the dried fish community, processors, and small traders, who are important for an inclusive and sustainable value chain operation. Second, to understand how the community and value chain actors, particularly the upstream actors in the empirical context of Odisha and the West Bengal coast of the Bay of Bengal, perceive the social-ecological system oriented dried fish value chain. Third, to explore the value chain and social-ecological wellbeing (material, relational, subjective, and ecological) connections to identify "value" that accounts for both capital and non-capital relationships among value chain actors within and across value chain nodes. This is to also explore whether the broader definition of value highlight market and ecosystem connections that benefit poor fishers, dried fish workers, processors, and market actors, often with mixed identities.

These aspects were examined using an interdisciplinary conceptual framework. This research is framed by drawing upon three critical theoretical areas that include value chains, a social-ecological systems perspective, and social-ecological wellbeing. Wellbeing is mainly focused on upstream actors, including fishers and dried fish workers. The focus of the research is on a greater understanding and analysis of the upstream segment of the dried fish value chain. Local

community and resource dynamics perspectives are important for responding to stakeholder agendas and emphasise global understanding of the diverse realities of dried fish systems (Glaser & Glaeser, 2014).

All three manuscripts (chapter II to chapter IV) presented in this dissertation thesis draw upon combinations of the above three theoretical areas. The first and second manuscripts (Chapters II and III) draw theoretical insights from the value chain, fisheries value chain, and social-ecological systems. However, the analysis of the third manuscript (chapter IV) is informed by a conceptual framework built on the literature on social ecological systems, small-scale fisheries value chain and social-ecological wellbeing. Additionally, Chapter III and Chapter IV use references from the novel hybrid theoretical framework of SES oriented dried fish that has evolved through this thesis research and was published in *Current Research in Environmental Sustainability journal*.

1.3.1. Value chain and dried fish operations

Value chains are used as the core conceptual framework to understand multi-layered interactions and exchanges between various market nodes and value chain segments (Gereffi et al., 2005). It is used to understand the capital and non-capital relationships within and across the value chain nodes and actors from a place-based and context-sensitive perspective. In addition, if offers the basis to understand the conceptual construct of "value" in the value chain.

The value chain is defined as the range of activities that are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky & Morris, 2000). The value chain node is understood as a step in the chain that helps in the value creation of a product through activities like production, processing, wholesaling, exporting, and retailing. Similarly, the value chain segment signifies distribution actors based on their role in the chain. We have considered three segments: the upper segment (fishers, small processors, and dried fish workers); the middle segment (larger processors, commission agents, and traders); and the lower segment (wholesalers, exporters, and retailers). Over the last decade, value chains have gained importance, especially in the food sector, as it is considered as one of the most important livelihoods strategies for rural communities (Reardon, et al., 2012).

A typical value chain approach focuses on three major aspects, i.e., structure, conduct, and performance (Attaie & Fourcadet, 2003). A *structural* perspective helps in systematically mapping the economic agents participating in the production, distribution, marketing, and sales of a particular product (or products). It also explains the distribution of benefits among economic agents in the chain and analyses the potential gain for each economic agent from increased organizational support (Attaie & Fourcadet, 2003). While the structure draws attention to the on different nodes and economic agents through profit points, the bio-physical resource system is only considered as part of the enabling environment. The notion of circulation, meaning exchange relations and the politics of buying and selling, govern the value chain of ecological products like dried fish. As a result, social-ecological dynamics (beyond the cost and revenue flow) are neglected at points of production, which have a strong bearing across chains as a whole (Baglioni & Campling, 2017).

Conduct describes the value chain behaviour that is often motivated by revenue multipliers through a linear system of exchange among economic agents (Kaplinsky & Morris, 2000; Rosales et al., 2017). Value chain analysis has explored the relationships between particular links in the chain, like buyer-seller dynamics, better than other linkages like different types of governance or forms of coordination, across the entire chain (Lowitt et al., 2015). The social-political construction of natural resources, and in this case, dried fish, is inherently relational. Just as humans determine natural resources through new use and exchange value, natural resources shape and determine the limits and potential of the production process (Baglioni & Campling, 2017).The behaviour among the actors is therefore extremely dynamic and non-linear. Value chain decisions often reflect tension between social and physical attributes of resources and chain adaptations. Moreover, the focus on profit in adaptation measures fuels competition within the chain for different end uses, market segments, and consumer base, e.g., dried fish for human use and animal feed. Horizontal factors are equally important as they help in analysing participatory, gender, labour, and environmental problems in the broader historical, social, and institutional context where the value chain is embedded (Riisgaard et al., 2010).

Value chain *performance* focuses on the value addition across the value stream and often places managerial importance on individual actors and nodes in the chain, perceiving the interaction in a vertical manner. In the case of ecological resources like dried fish, the feedback across the scale is often non-linear, and the interaction is dynamic and iterative in nature. Upgrading

function plays a role in value creation (Kaplinsky, 2000), either through improvements in quality and product design or by diversification in the product lines served, which is generally achieved through skill and technology (Attaie & Fourcadet, 2003; Rosales et al., 2017). Efficiency can be achieved by implementing management and technological changes in midstream (processing, value chain diversification, supply chain efficiency) and lower stream (forging complementary market networks among market players) with or without considering the upstream issues (fishers and dried fish workers).

There is no consensus among interdisciplinary scholars about the narrow connotation of value and also the process of value realisation (Fabinyi et al., 2018; Johnson, 2017). Discussions around value started taking on a more than financial considerations in fisheries' revenue stream. In fact, products like dried fish have 'social life' intertwined with both capitalist and non-capitalist relations, meanings, and practices (Fabinyi et al., 2018). Dried fish has strong roots in social and cultural practices of a given geographical context. Structural aspects like caste, class of actors, and gender relations (Belton et al., 2018; Johnson, 2017; Marshall, 2015; Ruddle & Ishige, 2010), require a complex system perspective for their full understanding. Further, unpredictable disturbances emanating from environment, social, and market factors have the potential to lead to large non-linear and irreversible changes in the value chain (Neven, 2014). It has also been observed that time, space, durability and distance factors relating to resource and livelihoods context may overpower market dynamics (Baglioni & Campling, 2017). Such factors include cost, revenue, price, and value chain character (small/large/local/regional/ international), and they pave the way for emergent behaviour on both the community and market side. While communities adapt to new system equilibrium either through livelihoods diversification or intensification (Nayak & Berkes, 2011), the market adapts with supply chain efficiency, diversification, and also pushing competing interests. Many adaptations are complementary business functions for value chain actors in the middle and lower stream and cause fishing practice and resource system characteristics to change. These adaptations also strengthen vertical integration in the value chain like industrial fishing houses with own hired crew and use of bag net with lower mesh size for trash fish extraction for growing non-human use (Béné, 2009). The capacity of dried fish resource system to remain within desired states has also been reduced due to the enhanced frequency and magnitude of abrupt changes from external drivers like climate change and market induced overfishing (Brander, 2007; Crona et al., 2015). Therefore, sectoral

economic approaches are less useful in the current situation. The self-organizing properties of complex ecosystems and associated management systems often cause uncertainty over time. Hence, there should be continuous learning and system adjustments. Each management action reveals to be an opportunity to further learn and adapt to changing circumstances (Folke, 2007).

There is a lack of consensus between pro-trade economic arguments and the non-capitalist arguments (environment, equity, social cultural aspects of production and exchange). Hence, there is a need to understand the dried fish sector using an approach that considers multiple drivers occurring across diverse scales, and that takes account diverse outcomes (Crona et al., 2015).

1.3.2. Social-ecological system and dried fish operations

The social-ecological systems theory is used as an analytical lens to reimagine the structure, conduct, and performance of the dried fish value chain. A social-ecological system (SES) is described as an integrated, coupled, interdependent, and co-evolutionary framework, and is characterized by non-linear vertical and horizontal feedbacks between ecological and social subsystems (Berkes & Folke, 2002; Nayak & Armitage, 2018; Walker et al., 2004). A SES perspective is accommodative of multiple realities and ways of understanding complex human-environment problems (Nayak & Berkes, 2011).

SES provides for complex, non-linear interactions between natural and societal sub-systems. It also helps in understanding resource management, governance, and sustainability at multiple scales (Berkes et al., 2003; Cumming et al., 2006; Ostrom, 2009; Walker et al., 2004). Further, SES units can be characterised by both physical and normative boundary considerations (Nayak & Armitage, 2018). It offers flexibility for researchers to look beyond issues either in the social or ecological domains and examine many related elements in the two component subsystems, i.e., (1) economy, culture, institutions, and politics within the social subsystem, and (2) biotic and abiotic processes representing the food web, and geological, hydrological, and climatological features of the ecological subsystem. Focusing on these subsystems as distinct parts of the larger social ecological system also promotes the development of their understanding because they are valued as integral to each other (Glaser, 2006; Kotchen & Young, 2007; Nayak, 2014; Turner et al., 2003).

SES research has established different attributes such as feedback, linkages, uncertainties, and emergences (Berkes et al., 2003; Biggs et al., 2015; Cilliers et al., 2013; Gunderson & Holling, 2002; Walker et al., 2004). The feedbacks are often nonlinear. They drive the dynamic interaction between the social and ecological subsystems, including their components and processes that impacts the structure, conduct, and performance of value chains (Binder et al., 2013). The non-linear feedback loops in the context of social-ecological systems are explained with a greater understanding of variables including intensification, diversification, specialisation, and social interactions (see Berkes et al., 2003; Berkes & Ross, 2016; Binder et al., 2013; Cash et al., 2006; Kooiman et al., 2005.; Nayak & Berkes, 2010; Sundkvist et al., 2005). Complex systems are characterized by dynamic sub-systems and cross-scale linkages within and across systems (Berkes, 2003; Berkes et al., 2003; Cash et al., 2006). Critical linkages regarding resources, roles, relationships, rules, and results determine the process of actor collaboration, competition for production, distribution, and consumption of goods and services. In contrast, most value chains operate in a predictable, mechanistic way. It emphasizes supply chain efficiency, which may lead to surprises in ecological products like dried fish. Change being rarely predictable, complex systems tend to organize around one of several possible equilibrium states, which increases uncertainty. Such uncertainty from macro and external processes like climate change, global trade policies, and international relations is sometimes beyond the control of value chain actors. At times, such internal and external conditions also encourage self-organisation of both market and resource systems via portfolio diversification or change in ecosystem service profiles. These events cannot be considered limitations and need to be factored into value chain governance. The dried fish value chain, like other food systems, incorporates complex environmental, social, political, and economic determinants across scale encompassing its availability, access, and utilization (Vroegindewey & Hodbod, 2018).

The social-ecological systems perspective has the potential to reimagine value chains as dynamic, non-linear, co-evolutionary, and ultimately, constitutive of linked social and ecological processes that are ‘co-productive’ (Marshall, 2015). Furthermore, the SES attributes can provide an analytical framework to analyse value chains, and place more emphasis on the resource system, resource communities, and various internal and external drivers of the dried fish system (Berkes et al., 2003; Bolwig et al., 2010; Cash et al., 2006; Nayak & Armitage, 2018; Nayak & Berkes, 2019a; Walker et al., 2004). These attributes are commonly used to explain the complex

nature and associated patterns of SES. They have multiple-trajectories possible as well as periods of fast and slow change ((Preiser et al., 2018), which is relevant to understand value chain dynamics.

1.3.3. Social-ecological Wellbeing

The term "value" in the dried fish “value chain” chain performance requires accommodating the diverse ways in which value is defined and framed. While SES governance literature will provide for the understanding of interactions across various nodes, values can be deeply held in people’s reasoning. In fact, values help relate to other cognitive constructs like knowledge and mental models, which guide life goals and life satisfaction. (Berenji et al., 2021; Jones et al., 2016; Schwartz, 1992). Anthropologists situate the value discussion within the framework of cultural specificity, relational identity, and non-capital exchange relationships beyond the market exchange framework of the value chain (Belton et al., 2022; Fabinyi et al., 2018; Pradhan et al., 2022). The question of relationality underpins the new meaning of the value of a commodity, that it is derived through its relationships with people and the environment in which it is produced. ((Johnson, 2017; Thompson & Open University, 1991). Small-scale fishers and dried fish operators often perceive value as material gain, relational dividends, place-based attachments, beliefs, and attitudes, with a sense of personal development, achievement, meaningfulness, and integrity (Allin & Hand, 2014; Dodge et al., 2012). Such a value orientation resonates with the social wellbeing narrative. Social wellbeing is defined as "a state of being with others, where human needs are met, where one can act meaningfully to pursue one’s goals, and where one enjoys a satisfactory quality of life" (Gough & McGregor, 2007, p. 316).

Social wellbeing is described in a three-dimensional framework that includes material, relational, and subjective wellbeing. Firstly, material wellbeing is achieved through the fulfilment of tangible and physical needs of individuals in relation to what they already have. Such needs are met through income, livelihoods, assets, shelter, food, and other physical resources. Secondly, relational wellbeing refers to the value derived through extant relationships and interactions with people and institutions. In fisheries for example, collaborations, social obligations, rules, social learning, and traditional knowledge systems are relationally meaningful. Finally, The subjective dimension of wellbeing explains how individuals find meaning, life satisfaction and how they perceive or understand life (Kahneman & Krueger, 2006). Subjective well-being delves into behavioural aspects like identity, equity, and adaptability that are highly place-based and

context-driven. The social wellbeing framework is quite evolved in terms of understanding diverse ways of value creation with adequate attention to context specificities and interactions with the resource system (Coulthard et al., 2011; Weeratunge et al., 2014). However, recent research shows that social wellbeing may not necessarily recognize the role of ecological and environmental factors that are instrumental in achieving sustainable outcomes. The full realisation of one's wellbeing will depend on social-ecological realities and conditions in an integrated way because human life is not compartmentalized. Scholars working on social-ecological systems promote the social wellbeing framework and social-ecological wellbeing framework with explicit considerations of resource system conditions and ecological outcomes (Armitage et al., 2012; Brueckner-Irwin et al., 2019).

Thus, social-ecological wellbeing provides a broader conception of social benefits than the one typically captured in the current fisheries value chain framework. The Marcus (1987) study provided an interesting analogy of dried fish, its value to the community and governance in Peru. At the time, he argued that Peruvian communities possibly looked at dried fish and fishery from the point of view of self-sufficiency and specialisation. During the late archaeological age, the rulers used specialisation as an opportunity to trade the resource. (Marcus, 1987). From the food and nutrition perspective, dried fish is the concentrated source of animal protein, essential micronutrients, and fats (Thilsted et al., 2014). The nutrition and food security of dried fish can be explained by three pathways. By consuming some of the fish they capture, and process, the dried fish workers and fishers are able to contribute to their food security and nutrition. Secondly, they can purchase other foods from the income generated through dried fish activity to improve their overall dietary intake. Since low-end processing activities are mostly controlled by women (Samanta et al., 2016), their control over family income impacts directly on household food security and nutritional outcomes (Kawarazuka & Béné, 2010). For example, in Malawi, a serving of 24 g of small dried fish twice a day provides an intake of calcium, zinc, and iron that is 327%, 152%, and 22% higher, respectively, than a daily diet without fish (Gibson & Hotz, 2001; Kawarazuka & Béné, 2010). Here, value and wellbeing may be perceived as food security and intergenerational equity issues rather than just employment and revenue issues. In a social and ecological setting, many other factors both influence and are influenced by the nature of the dried fish value chain. These factors include: the cultural context, caste identity, intergenerational skills, class dynamics, social life in relation to ecological resource systems,

societal positions (household and community level), gender relations, religious beliefs, taste and varied consumer preference, accessibility, durability and reach of products. Such considerations add to the subjective and relational wellbeing dimensions of dried fish.

However, social-ecological wellbeing provides an alternative way to understand outcomes. Just as importantly, it is an analytical lens that can help draw policy attention to the non- material benefits of fisheries (Brueckner-Irwin et al., 2019; Weeratunge et al., 2014). The key attributes of the wellbeing dimension that offer an understanding of contextual realities by combining social, economic, environmental, cultural, and political conditions as shown in table 1.1.

Table 1.1: Key attributes of social-ecological wellbeing

Theoretical basis	Wellbeing dimensions	Key attributes	Reference
Three-dimensional social wellbeing	Material wellbeing	Income, food, access to fisheries resources, other livelihoods and material supports	McGregor, 2007; White, 2009; Folke, 2016; Bruekner-Irwin et al., 2019
	Relational wellbeing	Learning and indigenous traditional knowledge, rules and enforcements, relationship with other value chain actors, collaborative decisions	
	Subjective Wellbeing	Place Identity, equity, adaptability	
Resilience	Ecological	Scale, disturbance, natural capital	

Value chains that do not consider the diverse ways people perceive the "value" of dried fish will continue to raise questions about its social and ecological appropriateness as well as its ability to benefit poor communities through their participation.

1.4. The conceptual framework of the study

All three manuscripts presented as three chapters of this dissertation thesis (Chapters II to IV) follow a specific conceptual framework. The frameworks are informed by the interplay of value chains, social ecological systems, and social-ecological wellbeing theory in the context of dried fish operations. Fig. 1 provides a comprehensive outlook of the conceptual grounding of the enquiries made to analyse the structure, conduct, and performance of the dried fish value chain through SES attributes. The horizontal and vertical linkages across dried fish value chain

segments are understood using an analytical framework of system attributes such as non-linear feedback, dynamic linkages, uncertainties, and emergence. In fact, the framework places greater importance on resource dynamics as an important and influential node in the value chain structure. Further SES attributes are used to analyse horizontal and vertical connections, relationships and interactions that are critical to understand the dried fish value chain conduct. The social-ecological wellbeing framework is perceived as the analytical tool to examine the diverse ways value chain actors, particularly fishers and dried fish processors, derive the meaning "value" in the dried fish value chain.

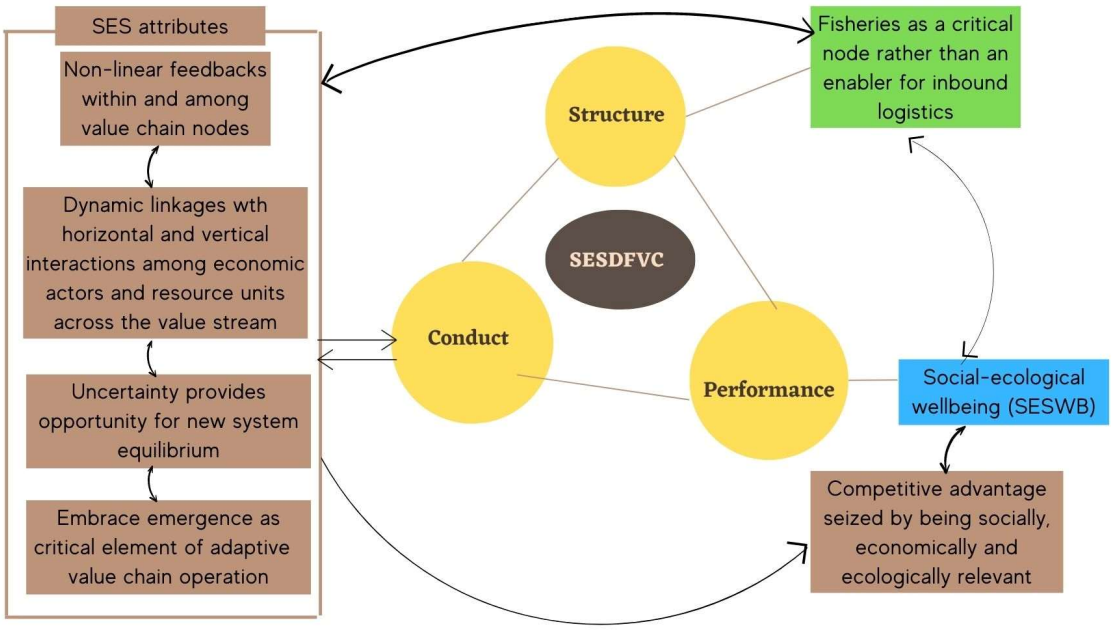

Figure 1.1: SES-oriented dried fish conceptual framework for wellbeing of fishers and small-scale dried fish processors

Further, three interrelated conceptual and analytical frameworks presented in the three results chapters provide a comprehensive view of social-ecological systems perspective of dried fish value chain and the broader meaning of value as social-ecological wellbeing. The first framework (figure 2.5, p.56) provides the novel conceptual framework of SES oriented value chain. The second framework outlines the interactions in SESFVC (figure 3.10, p.100). The third framework (figure 4.1, p.8) helps to analyse the value and performance of SESDFVC within a broader conceptual framing of social ecological wellbeing.

1.5. The Empirical context

The focal area of this thesis research is the eastern Indian coast of the Bay of Bengal, including Odisha and West Bengal. Originally, the research was planned to cover the entire dried fish value chain operational geography, including Odisha, West Bengal, and north-eastern states. However, due to the constraints of the COVID-19 pandemic, the locations were reconsidered without compromising on the key characteristics of site selection. The case-study sites were strategically chosen because of their strong interactions in both Odisha and West Bengal in terms of dried fish operations. Both sites have varied social-ecological characteristics. The first site is in the Jagatsinghpur district, near the Bhitarkanika Marine National Park. The site has unique features as it has a large estuarine area that is highly significant for conservation with strong floral and faunal diversity. It is a habitat for IUCN Red List species like sea turtles, crocodiles, and a rare species of white crocodile, besides having a rich mangrove forest. Sociologically, the area is also quite dynamic, with a large influx of Bengali fishers, who have permanently migrated from neighbouring West Bengal and Bangladesh. The people who have migrated from Bangladesh are mostly second time migrants meaning they first settled in West Bengal and then moved to Odisha from there. Except for two households, all the families have permanent residence on the study site and have electoral identity. Only four families are early settlers who belong to the Odia community, and they hold the political and social power in the village.

The second site is NM Padia village, which is about 10 km from the Digha border in West Bengal. Though the site belongs to Odisha, fishing and trade activities are mostly with the Digha-Mohana market. The people here are permanent settlers and belong to a fishing caste. They practice inshore fishing and work as crew members on West Bengal trawlers operating through the Digha-Mohana fishing dock. These communities have adopted drying practices from West Bengal fishers who used to visit and stay for about 5 months a year; they have been engaged in drying operations. With repeated natural calamities and growing interstate fishing vigilance, the annual migration from West Bengal has stopped, and the local fishers have started the drying practice. The area is experiencing a strong expansion of culture fisheries with the regular intrusion of West Bengal trawlers into the artisanal fishing area earmarked for artisanal fishers of Odisha.

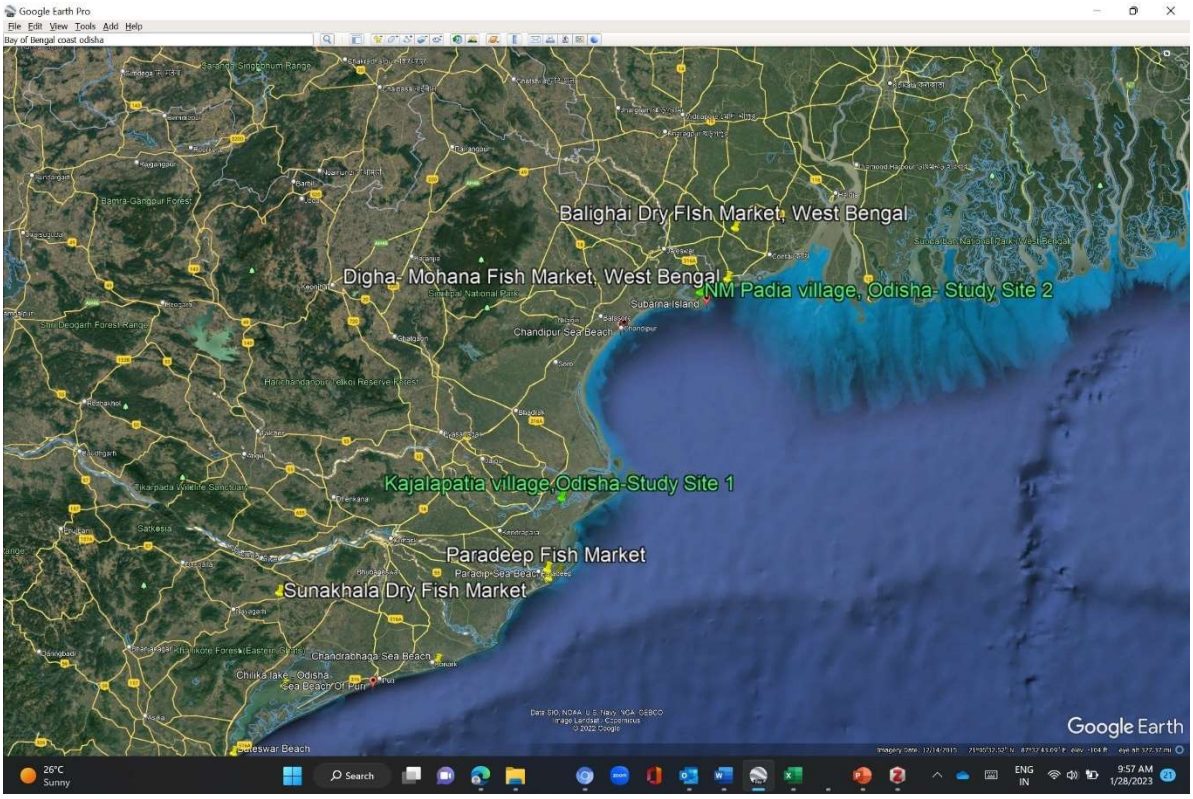

Figure 1. 2: Map of study locations case study sites indicating survey villages and dried fish markets [Source: Google Earth Pro version 7.3.6.9345, (December 2022). Bay of Bengal Cost. http://www.google earthpro.com (27 January 2023)]

The key characteristics of SSF and dried fish operations in the study sites are presented in Table 1.2. While site 1 is more ecologically diverse and has a greater degree of vulnerabilities emanating from social, economic, and governance factors, site 2 offers an interesting picture of the transition from the artisanal sector to the motorized sector with a greater interplay of inter-state actors and processes. From a social and economic perspective, site 1 provides a fragile societal position, with 96% of migrated communities having different linguistic identities, a lack of access to land and resources, and a relatively weak integration into local social-cultural processes. In contrast, site 2 offers a different picture of caste-based identity, permanent settlement, and stronger interactions with the social and political processes of the region. However, the common issues of both sites are widespread poverty, a lack of access to capital, and recurring losses due to the frequent extreme weather events, including cyclones and severe depressions.

Table 1.2: Key characteristics of study locations

Aspects	Site 1: Kajalapatia and Batighar	Site 2: NM Padia
Fishing area	Estuarine fishing and artisanal area fishing	On shore fishing
	Only 5.7% of fishers fish beyond artisanal area	Only 37% of people fish beyond artisanal area
Fishing Crafts	7% use traditional manual boats 90% use motorized boats (less than 8.5 meter) 3% use Sona boats	10% use traditional boats 53% use motorized boats (less than 8.5 meter) 37% use motorised boats above 8.5 meters length
Traditional norms and practices	*Uthia* and *Padia* fishing Mutual respect to fishing area	*Uthia* and *Padia* fishing
Actor roles	Mixed identity	Mixed identity and specialized operators
Time of fishing trips	89% fishers go for one day fishing trip	35% fishers go for one day fishing trips
Social relations	79% of the fishers and small-scale processors have migrated from West Bengal and Bangladesh. Lack of permanent land tenure Low political power Intergenerational knowledge and practice of fish drying	Permanent habitations with caste identity. Active participation in the local political process. Greater market access having interaction with both Odisha and West Bengal markets. Acquired knowledge of fish drying
Workforce dynamics	90% boat owners have hired crew from same communities. Shared fishing boats. Annual contract for boat drivers. Monthly contract for other crew members. Shared labour for processing. 89% of processors employ hired labour. 5% are self-employed enterprises.	50% boat owners have hired crew from same communities. Shared fishing boats Annual contract for boat drivers. Monthly contract for other crew members. Shared labour for processing 47% of processors employ hired labour. 53% are self-employed enterprises.
Work division	Male members do fishing, female members	Male members do fishing. Women

	engaged in fishing, processing, and selling.	do the processing. Men and women participate in selling.
Fish Production trend	Production has marginally increased but share of artisanal fishing is declining.	Production has increased but share of artisanal fishing is declining.
Production of preferred dried fish species	High catch unpredictability of preferred species. Competition of space by mechanized and power boats with motorized and non-motorized boats. 'C' class species availability for dried fish processors from the trawlers is inconsistent. Higher prevalence of household based self-employed processing units.	Decline in catch of dried fish species.
Weather vulnerability	Increased frequency of weather events including floods, cyclone, and depressions.	Weather events causing severe damages to processing infrastructure like drying racks, curing tanks, nets, and boats etc.
Policy induced vulnerabilities	Restriction of marine protected area and sea turtle conservation along with monsoon fishing ban (7months) causing long lean season of fish availability for drying. The seasonal advantage is lost.	Growing emphasis on aquaculture changing labour and catch dynamics for inshore fishing.

The dried fish value chain in the local context is mapped in Chapter III. The dried fish value chain is quite complex in terms of exchange relations, networks, and product movements. In the Kajalapatia and Batighar (site 1) regions, the dried fish value chain (DFVC) is strongly characterized by self-employed household enterprises run with their own and small dried fish units operationalized through household and hired labour. During the lean fishing period, besides their own catch, they buy "c" class fish from Nehru Bangala and Paradeep through auction. Based on the species, the price is negotiated. It varies from $0.14 (INR 10/- per kg) to $0.80 (INR 60/- per kg). Depending on the type of fish, the drying process in owned facilities reduces product weight reduction by about 50 to 70%. For example, the raw Chauli (Indian anchovy) fish is purchased at $0.28 (INR 20/-) to $0.55 (INR 40/-) per kg and is sold at $0.55 (INR 40/-) to

$2.40 (INR 180/-) when it's dried. The small shrimp are purchased at $0.28 (INR 20/-) to $0.80 (INR 60/-) and the dried shrimp are sold at $1.25 (@INR 100/-) to $2.50 (Rs 200/-) by the processors.

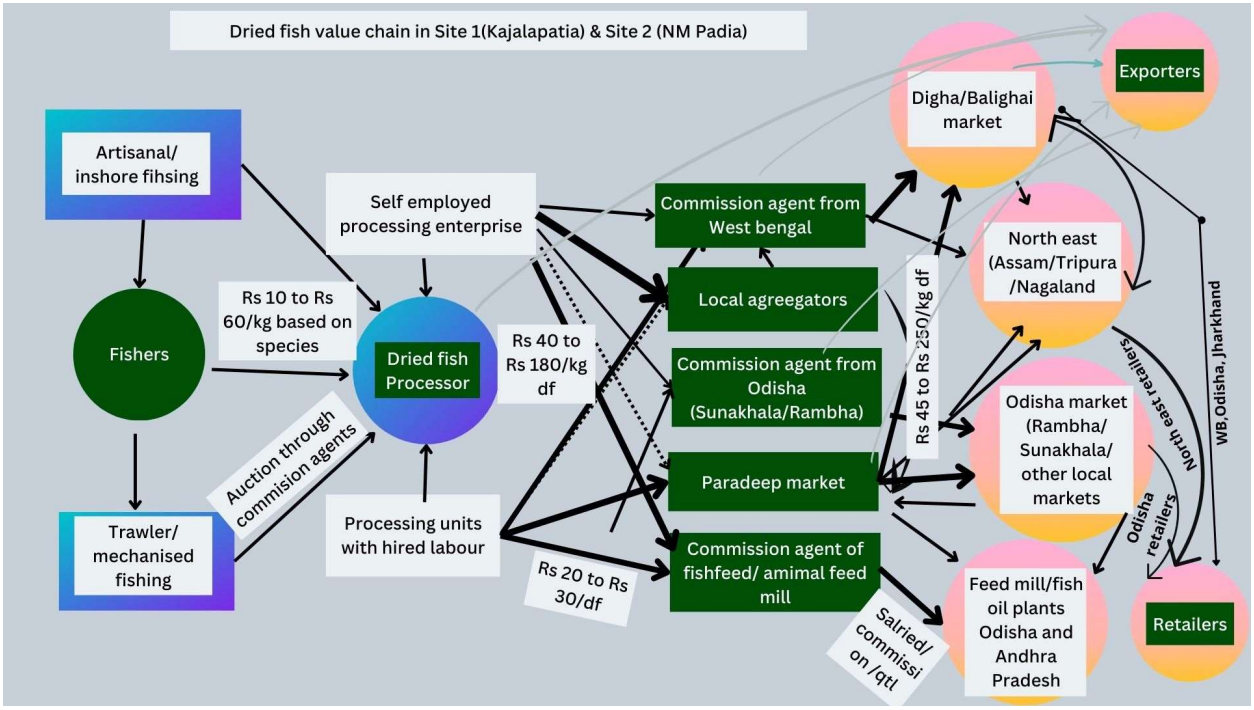

Figure 1.3: Dried fish value chain in study locations

As shown in Figure 1.3, dried fish moves through different means to the wholesale market and reaches the retail chain. A small portion of the dried fish that meets international quality standards is procured by exporters in Odisha and West Bengal. Exporters have their own commission agents and wholesalers who supply by performing additional grading at their end. Few exporters also procure directly from processing units with appropriate standard specifications. It is also found that there is a stronger connection between lower end value chain actors in terms of product procurement and marketing across Odisha, West Bengal, the North-eastern states, and Andhra Pradesh.

1.6. Research philosophy, design, methodology, and methods

This section presents an overview of the methodological design, approach, and constraints, as well as the rationale for the choice of methods used in the dissertation. Each of the manuscripts (chapters II, III, and IV) includes a detailed method section specific to the research question and objectives it addresses.

The doctoral research combines lenses from multiple theories to generate new insights on the dried fish value chain. The perceptions and insights of multiple actors across different segments of the dried fish value chain and resource system are considered to inform outcomes for policy and practice. Therefore, the research opted for a pragmatic research worldview as it allows researchers to be free of mental and practical constraints imposed by the "forced choice dichotomy between post positivism and constructivism'' and calls for a convergence of quantitative and qualitative methods (Creswell & Creswell, 2017, p. 27; Yvonne Feilzer, 2010). Pragmatists hold an "antirepresentational view of knowledge" that focuses on the notion of utility and thus allows a reflexive research process (Yvonne Feilzer, 2010). A pragmatic worldview allows the researchers to find meaning from the social, historical, political, economic, and ecological contexts with a clearly articulated purpose (Creswell & Creswell, 2017). It fits well with research on social-ecological systems as it is contingent upon specific historical, cultural, and societal narratives with a strong sense of place. In the context of the COVID-19 pandemic, such a research design also helped in readjusting the research processes by incorporating the dynamic and evolving situational realities. The pragmatic research design also helped in the adoption of a "properly integrated methodology" (D. L. Morgan, 1996) by acknowledging the value of both quantitative and qualitative research methods. The knowledge produced by such research is relative and has a strong commitment to uncertainties and unpredictability in human and environmental elements. Thus, it allowed for accommodating the complexities and messiness of social-ecological systems and mixed identities of dried fish value chain actors (Yvonne Feilzer, 2010).

We employed a mixed methods approach with a complementary research design that combines systematic literature review and field studies. A complementarity design is useful to examine different, but complementary aspects of the same phenomenon to address the research question. In this design, the researcher will have the flexibility to analyse and interpret data from multiple sources and studies concurrently and merge the findings into a single report (Golicic & Davis, 2012). The mixed method approach helps elicit complexities of views and participants' perspectives at the different levels of the value chain. It also offers the possibility to incorporate iterative and collaborative methods, which is critical to my research as it deals with problems that are strongly entrenched in community context, behaviours, and practice (Creswell & Creswell, 2017). The policy outcome orientation of the research demands meaningful

participation of fishers and others in deriving results. Further, I have used a convergent mixed method approach as it allows an iterative process of data collection and interpretation to derive overall results. It also helped me to conduct further probing in case of contradictions and incongruent findings with research participants (Creswell & Creswell, 2017). In the case of COVID-19 and multiple research locations in Odisha and West Bengal, this approach was quite helpful, as I could optimize my travel and data collection time with research participants by collecting quantitative and qualitative data simultaneously.

The field research was implemented through a case study approach. It provides for a comprehensive, holistic, and in-depth investigation of a complex phenomenon within its context, with a stronger participant's perspective (Creswell & Creswell, 2017; Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014). The case study approach helped to examine the "real world setting" of DFVC on the eastern coast of the Bay of Bengal, India, where the boundary between issues, actors, and contexts is relatively unclear (Yin, 2014). Furthermore, a case study research format was helpful in accommodating both qualitative and quantitative methods and could provide better insights into the how and why questions of the research (Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014).

The COVID-19 has brought challenges regarding the selection of methods of data collection. Multiple revisions are being made to the ethics protocol. The research proposal was designed with a mixed method approach with multiple research methods combining both qualitative and quantitative research tools and methods. It was proposed to employ methods including systematic literature reviews, semi structured interviews, focus group discussions, stakeholder workshops, and value chain surveys. However, considering the COVID-19 restrictions and protocols, multiple adjustments have been made to the study methodology. The methods that demand participant exposure were avoided. For example, focus group discussions and large community meetings were not conducted. At the same time, it forced changes in data collection processes that not only delayed the research work but also brought significant changes to the process of data collection. The research assistants were hired from the field location itself, as they would have greater awareness of the day-to-day emerging context in the community regarding COVID infections. The research assistants had to monitor the situation and help with the daily planning of data collection. In many cases, we had to adjust plans due to dynamic COVID scenarios. It also took longer to collect data from the market nodes and government

actors as it required them to be informed earlier, take prior appointments, and accommodate shifts in data, which were quite frequent. The research assistants were given thorough training and regular online as well as offline support to ensure quality data and adherence to COVID protocols while collecting data. Sanitizers and masks were distributed among all the research participants. The cost of data collection increased manyfold due to the longer stay in the field location and the use of personal vehicles to avoid public contact due to COVID ethics norms.

Secondly, considering the mobility challenges, the village level data collection was limited to Odisha state in the Bay of Bengal. One of the village survey sites is strategically chosen in the border area of West Bengal state, having strong value chain interactions with the Digha market in West Bengal. However, data for other value chain actors, including processors and traders, was collected from both the states. The selection criteria outlined in the proposal were followed strictly (Table 1.3).

Table 1.3: Study area selection criteria

Segment	Key respondents	Criteria	Considerations	Remarks
Resource node	Fishers, fish workers	Volume of production, number of fishers, proximity to processing centers, proximity to dried fish market	Village with high catch and a greater number of fishers Village with low catch with less number fishers	Market relations and interactions generally influenced by the volume and supply chain efficiency
Processing node and dried fish workers	Dried fish processors and workers	Size of the unit, capacity, technology use, value chain diversification, (dried fish & fishmeal/poultry feed)	Medium size processor, Self-employed enterprises, wage employment terms and conditions	Varied perspective to resource, market, and supply chain dynamics
Trade node	Wholesalers, retailers	Volume and size of trade, forward market, Sourcing	Both forward and feeder market for the dried fish processors in the study villages are considered for the data collection	They are critical players who determine place, market, financing dynamics

1.6.1. Research methods

A reconnaissance survey was first carried out to have a broader outlook on dried fish operations in Odisha and West Benghal. The survey offered an understanding of the area, general practices, and of the value chain geography based on specific criteria as discussed in Table 1.3. The methods used for this research include a scoping review of literature, a village survey, semi-structured interviews, and photographic documentation.

Scoping literature review

Academic literature on the dried fish value chain is somewhat limited. The lion's share of the literature is on technical aspects, mostly nutritional and hygiene analysis of dried fish (Belton et al., 2022). The systematic scoping literature review was relevant as a full-scale systematic review was not feasible due to the dearth of published literature (Arksey & O'Malley, 2005). The scoping review allows for mapping the essential concepts underpinning a study topic as well as the main source and categories of data available (Agarwal & Steinmetz, 2019). Scoping reviews are often undertaken with broad questions. The strategy used to identify literature in a scoping investigation must produce in-depth and broad results. The scoping review is guided by the requirement to identify all relevant literature, regardless of study design. It also allows researchers to refine search words and conduct more precise searches of the literature as their knowledge of the subject increases. The approach is iterative rather than linear, requiring researchers to engage with each stage reflexively and, when necessary, repeat steps to ensure that the literature is well covered (Arksey & O'Malley, 2005).

In this research, my search was guided by two broad aspects that include (a) SES attributes of value chains (dried fish, food value chains) and (b) the wellbeing perspective of fishers and small-scale dried fish processors. The search strategies were informed by two broad questions. The generic search with the criteria "anywhere in the document" generated a list of 65 peer reviewed journal papers. However, detailed scanning of these literature was found inadequate to provide an in-depth insight on the topic. Specific inputs and perspectives on our research objectives were thus scoped through a targeted search of literature with high topical relevance to dried fish systems that included dried fish value chains, small-scale fisheries (SSF) value chain analysis, social-ecological systems and SSF, food systems value chains, and pro-poor value

chain literature. A total of 72 peer-reviewed papers were assessed, along with other relevant literature and applied sources of information.

Village survey

A survey is defined as the collection of data with a well-defined study design for the purpose of scholarly investigation with a structured questionnaire. A survey is one of the most effective research tools that helps solicit mass opinion and views on complex issues in a democratic manner with widely distributed results. Surveys also carry the risk of sampling biases and involve some degree of interpretational autonomy (Kuechler, 1998). However, surveys have been accepted as one of the accepted methods of exploratory research, and they provide a strong platform of data and information that help in deciding appropriate sampling techniques and methods (Bhattacharjee, 2012; Kuechler, 1998). We conducted a census survey in two fishing and fish drying communities, covering all households in the habitation, to avoid sample bias and provide critical inputs and elements that required in-depth understanding from semi-structured interviews. The survey focused on upstream value chain segments, including fishers, dried fish processors, and dried fish workers who have mixed identities. Sixty nine percent of them are performing more than one value chain actor role. The survey covered 110 households from both study sites; a fisher household was considered the primary sampling unit. SES oriented dried fish value chain is a less studied area. The village survey helped in identifying critical value chain actors, nodes, and processes, along with a robust idea of the social-ecological setting of the production relations of the dried fish, which is as critical as the product itself. Further, the information obtained from the fishers and small-scale processors helped select respondents from other segments using the snowball sampling method. The effectiveness of the survey rests on clear and precise questioning with standardized and controlled administration of the questionnaire (Kuechler, 1998). The survey included questions regarding the resource context, the structure of the dried fish value chain, the behavior of market transactions, gender participation, resource access issues, asset use, livelihoods of upstream value chain actors, market access, interactions among value chain actors, and adherence to sustainability concerns.

The answers to structured questionnaires were pre-coded (i.e., for every question, the answer is either a number, or there is a predetermined set of answers to choose from). Since it is difficult to predict all the answers, rigorous field testing of the questionnaire was undertaken with the help

of local volunteers. Care was taken to keep the questionnaire brief and strategic so that it could be administered at a reasonable time considering the COVID-19 restrictions.

Semi-structured Interview

The semi-structured interview method is characterised by predetermined themes or questions with the flexibility of reframing them through a process of discussion between the interviewer and informant. Interviews are most likely to provide the depth of information that might be useful. This method is also useful for resolving ambiguity and conflicting information as the researcher has the direct opportunity to probe and determine the relative emphasis on various issues through direct interaction (Harrell & Bradley, 2009). Since the research is exploratory in nature without much previous reference, a semi structured interview method is better suited to get the relevant data (Creswell & Creswell, 2017).

Semi structured interviews with a small number of respondents require meticulous sampling to negate bias and ensure a representative view of the target population (Bhattacharjee, 2012). Sampling is the statistical process of selecting a subset (also known as a "sample") of a target population in order to make observations and draw inferences from the data (Bhattacharjee, 2012; Creswell & Creswell, 2017). Further, in the case of a value chain where there is a clear division of roles and functions among value chain actors across value chain nodes, each node acts as a statistically homogeneous group. The stratified random sampling technique provides a sampling frame that is divided into homogeneous and non-overlapping subgroups. Further, when the research covers a large geographic area with a disproportionate population of different subgroups, proportional stratified sampling offers greater accuracy in terms of the representativeness of the sample. The distribution of populations over different geographies can be better analysed with the help of multistage sampling that combines cluster sampling and proportionate stratified random sampling (Bhattacharjee, 2012; Creswell & Creswell, 2017; Kuechler, 1998).

Based on our research objective, we captured data from upper and lower segments of value chain actors, involving subgroups such as fishers, dried fish processors, and traders spread over a large geography. Therefore, a combination of cluster sampling and proportional Semi-structured interviews allow each respondent to focus on issues, which is critical for this research as the dried fish system is internally varied and shaped by diverse individual and community perspectives (Belton et al., 2022; Murray, 1998).

In person interviews were conducted at the workplaces of fishers, dried fish processors, and traders jointly with the local research assistants. A total of 68 semi structured interviews were conducted. The respondents included with various categories of value chain actors, with a greater emphasis on upper segment value chain actors like fishers and small dried fish processors. The sampling was relative to the number of actors operating in the study area and also reliant on the objective of the research to situate the value chain analysis in a social-ecological system (SES) perspective. SES calls for a place-based and contextual understanding of human-nature interactions, and, in the case of the dried fish value chain, "fisheries resources" are considered an important node. Hence, greater emphasis was placed on understanding the dynamics of the value chain from the perspective of fishers and dried fish processors, who often have mixed identities. The small-scale fishers also work as dried fish workers, dried fish processors, and sometimes as dried fish commission agents. As discussed in Table 1.4, out of a total of 68 respondents, 40 (59%) are fishers; 20 are dried fish processors (29.5%); and 8 are traders (11.5%). Since the research focuses on resource systems and upstream actors' positions in the value chain, 88.5% of the total sample size of respondents represent upper segment value chain actors.

Table 1. 4: An outlook of the semi-structured interview conducted in both the study sites (n=64)

Value chain actors	Kajalpatia, Batighar (Site 1)	NM Padia (Site 2)	Comments
Fishers	n=20	n=20	Fishers identified from the village survey
Dried fish processors	n=10	n=10	Identified from the data obtained through village survey
Traders	n=4	n=4	Data collected from the market nodes that include Digha-Mohana market, Paradeep market and Sunakhala market. Respondents identified through purposive and snowball sampling.

Qualitative Observation

The social-ecological systems perspective places higher importance to place-based values and non-linear interactions between human and environmental systems. Participant observation

method helps to understand the functioning of the place and the people within it from their perspective. The research process contributes to inductive theory building with a bottom-up approach instead of testing a hypothesis. It is carried out in the natural setting of the respondents. I spent considerable time spans over three dried fish seasons in the field study locations. Such a long stay helped to record the behaviour and activities of dried fish actors, particularly fishers, dried fish processors, and their collectives. The observations are mostly open ended and guided by free interactions with the research participants of the study site. Also, being in the study location for a long time helped to capture photographs of various processes of dried fish operations with due permission from the relevant actors.

Secondary data

Secondary data used in this study were obtained from published and unpublished sources. Unpublished sources mainly include fisheries department statistics, outcome budgets, and mandi records. The published sources include the fisheries handbook, the websites of the national disaster management authority and the state disaster management authority, the Central Marine Fisheries Research Institute (CIFT), the Marine Products Export Development Agency (MPEDA), and the Department of Fisheries and Animal Resources of the governments of India, Odisha, and West Bengal. Table 1.5 suggests that relevant statistics and information on the fishing community and dried fish operation has been obtained from all possible sources to substantiate the arguments presented in the SESDFVC analysis.

Table 1. 5: Sources of literature and key enquiries

Serial no.	Secondary data sources	Key enquiries
1	Indexed journal papers	Data on dried fish operation in Odisha and West Bengal. Data on specific attributes of social-ecological system oriented dried fish value chain (linkages, feedback, uncertainty, and emergence). Nutritional analysis of popular dried fish species.
2	Government publications (fisheries statistics, fisheries sector vision document, reports)	Statistics on small scale fisheries and dried fish operation (e.g., state wise and district data on catch, disposal, species, drying, trade and export, gear used, demographic composition, welfare schemes, credit)
3	Institutional websites and reports	Data on fishing crafts, gears, policies, sectoral plans, schemes, and budget.

4	Departmental records	Unpublished and recent data on fishing community, fish production, fish processing (curing), disposal, marketing, government investments, investment priorities.

Data analysis

A sequential approach was followed in analysing the literature, survey, and semi structured interview data. As discussed in the process matrix (Figure 1.4) a multi-level data analysis process was adopted. It involved detailed steps for quantitative and qualitative information collected through different data collection method such as the scoping literature review, village survey, and semi-structured interviews with value chain actors across value chain nodes.

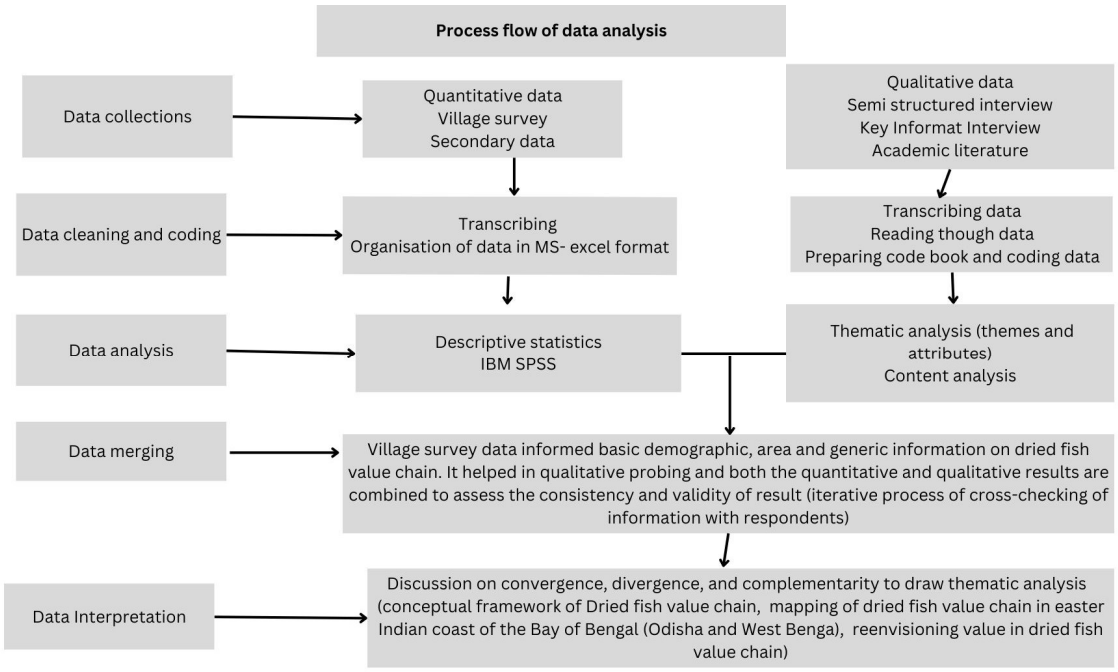

Figure 1. 4: Data analysis process

For the scoping review, a sequential analysis of the literature was conducted to organize and identify key insights. Firstly, value chain features were mapped, with particular emphasis on value chain structure, conduct, performance, and limitations. Secondly, the key features of the social-ecological systems view of a value chain in the context of dried fish were synthesized. Here, the emphasis was on feedbacks across scales, linkages (social-ecological), the role of uncertainty, and emergent properties. Thirdly, parameters of the dried fish value chain were

compared through the lens of conventional and social-ecological system perspectives, resulting in a framework that is consistent to the objectives of the thesis research.

Data cleaning and consistency were of the utmost priority for me. I adopted an iterative approach to ensure data quality and consistency. The semi structured interview answer sheets were carefully screened according to the questions as well as cross-checked with the information obtained from other sources, e.g., village survey and secondary data. In case of confusion, multiple rounds of field visits were conducted to clarify the doubt and ensure the reliability of the data. It was also important for me to take extra care with my positionality as a researcher, as I belong to Odisha and have long experience working with developmental issues in the geo-political context of the study region. Positionality has a significant impact on how knowledge is produced (e.g., research design, methodological decisions, data interpretation, and ethical practices) (Catungal & Dowling, 2021; Hopkins, 2007). Thus, it was essential to maintain critical reflexivity throughout the research process (Hopkins, 2007; Yin, 2014). I was conscious of my positionality and reflexivity to maintain awareness between insider and outsider perspectives with openness to appreciating the respondent's perspective throughout the data collection and analysis.

The village survey and semi-structured interview data were first transcribed into classified content. The analysis was done by combining qualitative coding following an inductive approach that allowed new themes and iterative rounds of open coding (Plummer et al., 2012) and descriptive statistics with the help of SPSS software. While coding qualitative responses, different values are assigned to different segments of responses. The responses from the fishers' segment are coded as F1...F40, processors as P1...P40, and traders as T1...T8.

1.7. Ethics protocol and related safety considerations

The research complied with the University of Waterloo Statement on Human Research (2018) and was consistent with the Tri-Council Policy on Research Involving Living Human Participants (TCPS 2, 2014). The core principles of this policy—respect for people, concern for welfare, and justice—were maintained while conducting research. The approved Ethics Protocol for the field research (ORE # 41888) addressed all relevant considerations and risk mitigation, including, informed consent during participant recruitment; protecting privacy, anonymity, and confidentiality; data storage and password protection; reciprocity, trust, and relationships. The initial ethics protocol was revised with the change in the ethics process due to the COVID-19

situation. At the University of Waterloo, on-field research was banned for almost a year which delayed the research work on the ground. As a result, I missed two dried fish seasons, even though I was stationed in the study locations. However, the constant interactions with the ethics office and compliance with the COVID research process helped in obtaining the amended ethics approval, which had a revised protocol. Apart from methodological adjustments for data collection, additional personal and research participant safety protocols were laid down to guide the research process on the ground. Compliance with the public health guidelines of local authorities was the priority in data collection. As a result, methods such as focus group discussions and community meetings were avoided. This called for an iterative process of information collection about study locations, respondents' health situations, and ensuring respectful behaviour. The field research was conducted in compliance with a COVID-19 Safety Plan to minimize potential exposure to COVID-19 during in-person field activities and was approved by the University of Waterloo's Office of Research (Appendix B).

1.8. Organization of the Dissertation

The dissertation consists of five chapters, including the introduction chapter. The following three chapters (chapters two to four) are independent manuscripts developed on three objectives of this PhD research. The last chapter is the concluding chapter.

Chapter II addresses the first objective and provides a novel theoretical framework for a social-ecological system oriented dried fish value chain. The framework is the outcome of a detailed scoping review of the value chain, small scale fishing value chain, dried fish, social ecological systems, and wellbeing literature. 120 peer reviewed journal papers were objectively analysed to identify the gaps and rationale for a novel framework for the wellbeing of upstream value chain actors, including fishers and dried fish processors, who are operating at the exploitative end of the value chain. The manuscript is titled "A social-ecological systems perspective on the dried fish value chain" and was published in Current Research in Environmental Sustainability" (Ref: Pradhan, S. K., Nayak, P. K., & Armitage, D. (2022). A social-ecological systems perspective on dried fish value chains *Current Research in Environmental Sustainability*, *4*, 100128 (https://doi.org/10.1016/j.crsust.2022.100128)

Chapter three builds on the conceptual framework of the social-ecological systems oriented dried fish value chain (SESDFVC) developed under objective one. It provides an empirical outlook of

the dried fish value chain in relation to SES attributes in the context of the eastern Indian coast of the Bay of Bengal, including Odisha and West Bengal. The manuscript is titled "Mapping Social-Ecological-Oriented Dried Fish Value Chain in India: Evidence from Coastal Communities of Odisha and West Bengal." The manuscript has been submitted to the Coasts journal for publication. The manuscript is co-authored by Prateep Kumar Nayak and C. Emdad Haque.

Chapter IV delves into Objective three of this doctoral research. It is an empirical paper that challenges the neo-classical economic construct of "value" in the value chain. The paper discusses value under the broader premise that it appreciates the diverse ways people derive value from the dried fish system. The analysis of value uses a hybrid framework of "social-ecological wellbeing" that takes into consideration both the theoretical understanding of social wellbeing and the social-ecological system (Brueckner-Irwin et al., 2019; Nayak & Pradhan, n.d.). The manuscript is titled "Reimagining value as social-ecological wellbeing in dried fish value chains" and it is co-authored by Prateep Kumar Nayak. The manuscript is being finalized for submission in the Poverty Journal of Taylor and Francis.

Chapter V summarises the key research findings. It also outlines the theoretical and practical contributions of the research, its limitations, and future research directions. The chapter also presents an overview of additional challenges and measures of adaptation to global uncertainties like the COVID-19 pandemic.

At the end, a list of references to all the literature sources used in the dissertation is presented in alphabetical order. The appendices referred to within this introductory chapter are also included at the end of the dissertation as a series of appendices.

Chapter II

A social-ecological systems perspective on dried fish value chains

2.1. Abstract

Small-scale fisheries (SSF) support over 90 percent of the 120 million people engaged in fisheries globally. Dried fish is an important sub-sector of SSF, which is characterised by the declining social, economic, and political conditions of people involved in its production and the ecosystems they depend on. Dried fish accounts for 12% of the total fish consumption globally but can increase up to 36% in low-income countries. About half of the people involved in dried fish production and marketing are women. The approach taken to analyse dried fish sector has so far followed a narrow subset of commodity chain approaches with a focus on financial value, transmitted in a linear 'vertical' fashion across value chain actors. The existing value chain approach fails to factor in the non-capital relationships of dried fish that are contingent upon specific histories, ecologies, peoples, places, and practices. The narrow neoclassical economic perspective of the dried fish value chain (DFVC) also impedes appropriate responses to its unique attributes pertaining to social, ecological, and institutional interactions across multiple scales. Failure to consider social-ecological system (SES) attributes, its connections, and relationships with the dried fish value chain not only undermines the social wellbeing of upstream actors but also perpetuates social-environmental inequity and injustice. The paper offers a novel SES-oriented DFVC perspective that focuses on the social wellbeing of fishers and dried fish workers. The reconceptualization of structure, conduct, and performance of DFVC is done by conducting an interdisciplinary analysis of peer-reviewed literature from SES, value chain, and social wellbeing.

2.2. Introduction

Dried fish has long been an integral part of south and southeast Asian food systems, social-cultural processes, and the regional and global fish trades (Marcus, 1987; Ruddle & Ishige, 2010). We use the FAO definition of dried fish, which includes products that are cured, salted, preserved in brine, and/or smoked (FAO, 2015). Rich in calcium and other micronutrients, dried fish consumption and trade is significantly larger in low-income countries, where it acts as a

significant source of food and nutrition in both coastal and arid mountainous regions (Belton & Thilsted, 2014). The Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the context of food security and poverty eradication also consider fishing and dried fish processing as important drivers of food security and poverty eradication (FAO, 2015).

Dried fish, however, has been largely neglected in global, regional, and national analysis despite constituting about 12% of the global fish production (FAO, 2015) and making crucial contributions to the nutritional and social wellbeing of the poor (Thilsted et al., 2014). The trade focus and increasing capitalization of commercial fishing has posed serious challenges to the dried fish economy and ecology, including the livelihoods of dried fish processors, small traders, and poor fish workers engaged in the sector (Dey & WorldFish Center, 2008). This raises serious questions about the efficacy of maintaining a conventional value chain approach in policy development in the context of a multidimensional, complex, and highly dynamic dried fish subsector. Value chain analysis has been a preferred approach over other trade theories in explaining why the poor may face barriers to trade, and recent work has highlighted significant gaps in its ability to address non-trade (and economics) to include social, cultural, and ecological challenges (Altenburg, 2007; Mitchell et al., 2009).

A value chain framework offers an understanding of multi-layered interactions and exchanges between various market nodes with a strong focus on economic returns (Gereffi et al., 2005).Value chains address limitations regarding understanding and analysing entry level barriers of poor producers and distribution of benefits to all actors across the entire chain. However, the focus is largely on the economic multiplier effects of input-output relations between firms and systematic competitiveness across scales (Kaplinsky & Morris, 2000). Interdisciplinary scholars have contested such neo-classical economic perspective that singularly considers natural resources as commodities (Fabinyi et al., 2018; Johnson, 2017; Nayak & Berkes, 2011). In the case of products like dried fish that are embedded in particular social, ecological, political, cultural, and geographic contexts, they cannot be considered in isolation from the multiple ongoing social and ecological processes, dynamics, and relationships (Adger, 2006; Jentoft, 2000). For example, a fisheries value chain with a primarily financial orientation fails to factor in the essential characteristics of the product with regard to its non-capital relations that are contingent upon specific histories, ecologies, people, place, and the practices therein (Fabinyi et al., 2018; Failler & Pan, 2007; Ruddle & Ishige, 2010). Further, a lack of

consideration of nutrition and food system perspective in dried fish value chain policy and investment (Ahmed & Lorica, 2002) limits appropriate responses that are matched to complex social, ecological, and institutional interactions across multiple scales (Ericksen, 2008; Marshall, 2015). This calls for novel approaches that can help develop more inclusive and holistic understanding of value chains, with specific reference to dried fish.

The objective of this paper is to examine if and how a social-ecological systems perspective may offer a comparative advantage to cohesively analyse the horizontal and vertical factors inherent in dried fish value chains in small-scale fisheries (SSF) contexts. As such, our analysis draws attention to the need for a conceptual departure from a neo-classical economic orientation of dried fish value chains to an emphasis on linked social-ecological systems (SES) perspective. A social-ecological systems perspective is defined here as an integrated, coupled, interdependent and co-evolutionary system with mutual vertical and horizontal feedbacks between ecological and social subsystems (Berkes et al., 2003)

2.3. Methods

To characterize and frame an alternative social-ecological perspective on dried fish value chains, we use a scoping review of the literature with direct and indirect relevance to the dried fish economy and actors engaged in dried fish value chains, particularly small-scale dried fish producers and workers. The scoping review was undertaken with two objectives: 1) to understand the extant value chain characteristics of dried fish; and 2) to outline the key social-ecological attributes of the dried fish value chain that accommodate contextual reality and dynamic ecosystem-human interactions through an interdisciplinary analysis. Literature databases, including Scopus, ProQuest, Science Direct, and the Dried Fish Maters (DFM) Global Literature Archive, were scanned using specific key words and search criteria. A combination of key words such as "dried fish and value chain," "dried fish and SES," and "dried fish, value chain, and SES" were used when only considering the peer reviewed journal papers.

Literature on dried fish value chain is somewhat limited, and a significant portion of the existing scholarship focuses on technological aspects, including drying techniques and quality enhancing parameters (see https://diredfishmatters.org). Therefore, strategic investigation of the targeted research questions was made through an explicit approach to identify, select, and examine allied literatures to empirically enhance the scope of our analysis beyond the ‘conventional’ dried fish literature. Specific inputs and perspectives on our research objectives were thus scoped through a

targeted search of literature with high topical relevance to the dried fish system that included dried fish value chains, small-scale fisheries (SSF) value chain analysis, social-ecological systems and SSF, food systems value chains, and pro-poor value chain literatures. A total of 72 peer-reviewed papers were assessed, along with other relevant literature and applied sources of information.

We analyzed the literature in a sequential manner to facilitate organization and identify key insights. First, we outline the key features of conventional value chains and their limitations and highlight in particular the importance of value chain structure, conduct, and performance. Second, we synthesize the key features of a social-ecological systems view of value chains in a dried fish context, drawing on the main theoretical and empirical contributions from documented applied research and the relevant literature. Here, our emphasis is on feedbacks across scales, linkages (social-ecological), the role of uncertainty, and emergent properties. Third, we compare and contrast dried fish value chain parameters through the lens of conventional and social-ecological system perspectives and offer a framework that better accounts for complexity in the system.

2.4. Value chains and their limitations in a dried fish context

A value chain is defined as the range of activities that are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky & Morris, 2000). A fishery value chain is defined as a set of interlinked value-adding activities that convert inputs into outputs, which in turn, add to the bottom line and help to create competitive advantage for the fishery business (De Silva, 2011). Over the last decade or so, value chains have gained importance, especially in the food sector, as an analytical tool (Reardon, et al., 2012; Stoian et al., 2012). The FAO (2005) technical guidelines for responsible fisheries have also placed stronger emphasis on value chain development of fish processing, trade, and poor-friendly market systems for enhanced economic efficiency and welfare gains in developing countries. Indeed, the value chain approach has been recognised for its advantageous role in analyzing interlinkages and dynamic interactions across actors, institutions, and policy environments in an integrated manner that goes beyond a farm and even sectoral boundaries (Kaplinsky & Morris, 2000).

The typical value chain approach for sea food products can be simultaneously considered as narrow as well as broad. The narrow approach provides for a range of actions taken by a farm to produce certain outputs. A broad approach outlines the activities of an enterprise, and the interactions among economic agents involved in the movement of products from raw materials to consumers with an understanding of backward and forward linkages (Rosales et al., 2017). In most cases, fisheries value chains follow a financial approach and have limitations when factoring in non-capital relations (Fabinyi et al., 2018a). Fundamentally, dried fish value chain analysis, just like other economic value chains, focuses on three major aspects: structure, conduct, and performance (Attaie & Fourcadet, 2003; Belton et al., 2018).

A ***structural*** perspective helps in systematically mapping the size of the chain and its functionality in terms of the positioning of economic agents participating in the production, distribution, marketing, and sale of a particular product (or products). It also explains the distribution of benefits among economic agents in the chain and analyses the potential gain for each economic agent from increased organisation support (Attaie & Fourcadet, 2003; Belton et al., 2018; Rosales et al., 2017). While the structure highlights the importance of different nodes, segments, and economic agents through profit points, the biophysical resource system is considered only as a part of the enabling environment and, therefore, remains neglected and excluded. The value chain node is understood as a step in the chain that helps in value creation of a product, such as production, processing, wholesaling, exporting, and retailing. Similarly, a value chain segment signifies the distribution of actors based on their role in the chain. We have considered three segments: the upper segment (fishers, small processors, and dried fish workers), the middle segment (larger processors, commission agents, and traders), and the lower segment (wholesalers, exporters, and retailers). The resource system refers to the ecological resource base that comprises multiple resource units and multitier users (Ostrom, 2007). For this paper, we considered coastal fisheries as a resource system and the preferred species used for drying as a resource unit.

The value chain structure is primarily guided by the notion of circulation, i.e., exchange relations, and the politics of buying and selling are determined by cost and revenue flows. Such structural considerations limit the ability of the value chain to consider ecological and contextual social factors at points of production (see Baglioni & Campling, 2017; Béné et al., 2010). It

often leads to the misallocation of limited resources and propels choices antagonistic to positive results for the fishers involved in production systems.

Value chain ***conduct*** describes the economic behaviour that is often motivated by revenue multipliers through a linear system of exchange among economic agents involved in the value chain (Kaplinsky & Morris, 2000; Rosales et al., 2017). In case of the fisheries value chain, the value chain conduct deals with provision of goods and services and the nature of relationships among the actors in the chain (Belton et al., 2018). Value chain analysis has been effective in promoting relationships between particular links in the chain (e.g., between a buyer and supplier). Driven by the logic of profit, the lower end value chain actors, such as traders, retailers and customers are especially interested in price, convenience, and hygiene of the product. Their concerns for environmental sustainability and wellbeing of fishing communities and dried fish producers are either low or absent. In fact, the upper end value chain actors (fishers, small curers, dried fish workers) are often challenged with factors like lack of quality measures, improper market information, and lack of power in the market (De Silva, 2011; Schuurhuizen et al., 2006). The trade investment in both fishing and fish processing is rather accentuating the problem with vertical consolidation of supply chain, overfishing, loss of traditional jobs and shrinking access to resources by small-scale fishers (Béné, 2009; Nayak, 2014; Schuurhuizen et al., 2006). Often value chain analysis of natural resource products, in this case dried fish, lack adequate understanding of actor behaviour and linkages, or the forms of coordination that are inherently relational, dynamic, and non-linear (Lowitt et al., 2015). The fishing and fish processing practices are often characterized by strong social norms, kinship and other unique relationship networks with context specificities which are inherently varied (Johnson, 2017). However, dried fish is often an essential part of local food systems, relates to people's positions within these systems, and signifies patterns of interactions between actors, particularly people in low-income groups and with limited cashflow (Arthur et al., 2021).

Value chain ***performance*** focuses on the value addition across the value stream and often places management importance on vertical interactions between individual actors and nodes. However, in the case of ecological resources like dried fish, the feedbacks across scales are often non-linear and interaction is dynamic and iterative in nature. In typical fisheries value chains, upgrading function plays a role in value creation (Kaplinsky, 2000) either through transformations in terms of quality and product design or by diversification in the product lines which is generally

achieved through skill and technology enhancement (Attaie & Fourcadet, 2003; Rosales et al., 2017). Further efficiency is achieved by bringing management and technological changes in midstream (processing, value chain diversification, supply chain efficiency) and lower stream (forging complementary market networks among market players) with or without considering the upstream issues (fishers and dried fish workers). In recent years, there has been greater discussion on value chain performance within the small-scale fishery sector, with specific attention to inclusiveness, efficiency, and product quality (Belton et al., 2018). However, in most cases, the transformative processes are led by the commercial actors, who ensure control of all dimensions of fisheries food systems, leaving the poor fishers and fish processors in a disadvantaged position (Arthur et al., 2021). With a clear emphasis on efficiency and quality control, value chains operate in a predictable, mechanistic way and rely on repetitive linkages and interactions between actors and organisations in the chain (Kaplinsky & Morris, 2000). In contrast, the wicked problems associated with fisheries are rarely predictable and often beyond the control of value chain actors (Khan & Neis, 2010). Further, the capacity of fisheries resource systems to remain within desired states has been challenged by the increased frequency and magnitude of abrupt changes through external drivers such as climate change and market induced overfishing (Brander, 2007; B. I. Crona et al., 2015). In this context, sectoral economic approaches are less useful as they treat uncertainties as risks and sometimes ignore the limitations of the conventional value chain. Hence, there is a need to understand value chains using approaches that facilitate multiple possibilities, diverse equilibrium states, accommodate multi-level drivers, appreciate socio-cultural specificities, and respond to their impacts (Adger, 2000; Finkbeiner, 2015; Nayak & Armitage, 2018).

The production space (fisheries) is not exogenous to dried fish value chain structure as ecological processes such as competition, environmental surprises, vulnerabilities, and habitat characteristics have a stronger bearing on the bio-economic dynamics of a product. According to Bagloni and Campling (2017, p. 2445), "just as humans determine natural resources through new use and exchange value, natural resources shape and determine the limits and potential of production processes." There has been more emphasis recently on resource issues within sustainable business discourse, but it has mostly focused on market tools such as environmental labels and certification from systematic competitive trade advantage perspectives (Bolwig et al., 2010; Donald, 2004; Ponte, 2008). In this case also, insignificant attention is paid to the

integration of horizontal and vertical interactions in the entire chain, which is strongly influenced by contextual factors relating to social relations, environmental dynamics, and local history (Bolwig et al., 2010). This narrow perspective of value chain analysis and a lack of appreciation of the interplay between vertical and horizontal factors pose multiple challenges to the effective participation of upper value chain segment actors, which include poor fishers, dried fish producers and fish workers. Dried fish is a typical subsector where producers are mostly household and other small-scale operators, end users are poor and most of the actors have multiple identities as fishers, processors and even aggregators. These actors encounter several adversaries and competing use of inputs such as small fish for fish meal and animal feed, extractive fishing (with use of gill net and bag nets), reducing fish stock of preferred species for dried fish, non-tariff barriers (ecolabels, quality standards and certification), low capacity of fishers and small-scale processors to comply with hygiene, sanitary and phytosanitary standards associated with food products (Béné, 2009; WTO, 2017).

On the contrary, within the fish and fish product value chain context, positive outcomes from the chain rest on fair distribution of benefits and the connections with the broader historical, social, ecological, and institutional context in which value chain is embedded (Belton et al., 2018; Béné et al., 2010). Such relationships are manifested through traditional ecological knowledge of informally managed small-scale fisheries (Chacraverti & Basu, 2014). For example, In West Bengal, India, fishers' decision to sequence fishing intensity based on the tidal patterns influenced by lunar cycles, judging catch dynamics from the sound of water, predicting change in weather from wind direction in the sea speak volumes about their ingenuity and meanings they associate with their livelihoods and resources (Chacraverti & Basu, 2014). However, inadequate emphasis on these crucial human-environment factors by fishing enterprises and market forces have turned fishers into passive contributors instead of active collaborators in value chain processes (see Lam & Pitcher, 2012). Management options may be better analyzed with a systems perspective that involves a technology-actor-institution and resource nexus at various scales (Burch et al., 2014; Westley et al., 2011). In this regard, a social-ecological system analysis has the potential to expand this discussion by involving place-based social, cultural, and ecological transactions, knowledge, norms, and behaviour to inform the conduct of the value chain at different scales of operation.

2.5. A social-ecological perspective on dried fish value chains

Berkes et al. (2003) describes social-ecological systems (SES) as integrated, coupled, interdependent and co-evolutionary, and characterized by non-linear vertical and horizontal feedbacks between ecological and social subsystems (Berkes & Folke, 2002; Nayak & Armitage, 2018; Walker et al., 2004). A SES perspective also accommodates multiple realities and multiple ways of understanding complex human-environment problems (Nayak & Berkes, 2011), and counters the idea of discrete management models that operate without a holistic view of both the social and ecological subsystems (see Berkes & Folke, 2002; Fabinyi et al., 2014). This social-ecological systems perspective can help reimagine value chains as dynamic, non-linear, co-evolutionary, and ultimately, constitutive of linked social and ecological processes that are 'co-productive' (Marshall, 2015). Recent literature has emphasized the value of an SES perspective in understanding the importance of relationships, interactions, and connections (Kates et al., 2005; M.E.A, 2005; Nayak, 2014), and the manner in which social-ecological systems (and sub-systems) have both physical and normative boundaries (Marshall, 2015; Nayak & Armitage, 2018).

Further, key attributes of SES can also provide an analytical framework through which to analyze value chains, and place more emphasis on resource system, resource communities and various internal and external drivers of the dried fish system (Berkes et al., 2003; Bolwig et al., 2010; Cash et al., 2006; Nayak & Armitage, 2018; Nayak & Berkes, 2019; Walker et al., 2004). Table 2.1 summarizes selected SES attributes which provide a more comprehensive and integrated perspective of dried fish value chains, including the importance of feedback, linkages, uncertainty, and emergence (Biggs et al., 2015; Cilliers et al., 2013; Gunderson & Holling, 2002; Walker et al., 2004). These attributes are commonly used to explain the complex nature and associated patten of SES witnessed with multiple-trajectories possible, periods of fast and slow change. (Preiser et al., 2018). We synthesize below the theoretical and empirical contributions of these attributes to the analysis of dried fish value chains.

Table 2. 1: SES attributes and key variables for understanding dried fish value chains.

SES attributes	Variables of interest	Rationale for choice of attributes and variables	Key references
Feedback	Intensification, diversification,	Contribute to understand and study the economy as being an "adaptive	Berkes & Ross, 2016; Binder et al., 2013; Cash

	social relations	nonlinear network" of human action vis-à-vis natural system response	et al., 2006; Cinner & Bodin, 2010; Fabinyi, 2010; Fabinyi et al., 2018; Grunert et al., 2005; Jayasinghe & Thomas, 2008; Johnson, 2017; Nayak & Berkes, 2011; Sundkvist et al., 2005; Van Tuyen et al., 2010
Linkages	Rules, resources, relationships, roles	Critical to understand the ecological importance of ecosystem services, as well as how humans value and experience those services, which in turn conditions their actions and responses to the social-ecological system. Collins et al., 2010	(Adger, 2000; Andrew et al., 2007; Berkes, 2003; Berkes et al., 2003; Birner & Wittmer, 2004; Cash et al., 2006; Collins et al., 2011; B. I. Crona et al., 2015b, Grunert et al., 2005; Kleih et al., 2003; Nayak, 2014; Stoian et al., 2012)
Uncertainties	Supply vulnerability, demand vulnerability, process uncertainty, policy, and control	Uncertainties is critical attribute in both SES and value chain literature as it explains the system complexities and help in anlysing the system beyond a predictive risk management framework	Biggs et al., 2015; Charles, 1998b; Larson, 2004; Levin et al., 2013a; Ortiz et al., 2019; Sai Global, 2020; Sethi, 2010
Emergent properties	Spatial features, place-based values, socio-legal arrangements, practice, and skills	To argue that the behavior of a complex adaptive system of value chain as a whole is a relational and emergent property	(Cilliers et al., 2013; Jayasinghe & Thomas, 2008; Moore et al., 2018; Nayak & Armitage, 2018; Nayak & Berkes, 2019; Schlüter et al., 2019)

2.5.1. Feedbacks in dried fish value chain

Small-scale fisheries and related trade dynamics result in multiple patterns of interactions with varied outcomes, such as changes in fish stocks, extraction/harvesting patterns, environmental conditions, competition among agencies and actors and economic return to various chain actors (see Crona et al., 2016). The feedbacks are often nonlinear. They drive the dynamic interaction between the social and ecological subsystems, including their components and processes (Binder et al., 2013) that impacts the structure, conduct and performance of value chains. We consider variables such as intensification, diversification, specialisation, social interactions that are used to analyse nonlinear feedbacks in social-ecological systems and discuss them in the context of primary and secondary feedback loops as experienced in value chain operations (see Berkes, 2015; Berkes & Ross, 2016; Cash et al., 2006; Kooiman et al., 2005; Nayak & Berkes, 2011; Sundkvist et al., 2005).

Figure 2.1 outlines variables of nonlinear feedback and their understanding in the context of dried fish value chain. First, intensification is seen as a common strategy adopted by different actors involved in fisheries operations (McCay, 1978; Nayak, 2017; Van Tuyen et al., 2010) . Intensification refers to change in practice of fishing, fish processing and trade with certain technological, geographical, species, labour arrangements, market competition and collaboration (Fabinyi, 2010). All these parameters are expressed differently, but they have strong bearing on each other across value chain segments. For example, in the case of the upper end value chain actors, including fishers and small-scale dried fish processors, technology intensification signifies changes in fishing gear, geographic intensification suggests spaces within which catch is obtained, and species intensification is related to catch size and composition. Similarly, labour dynamics in upper end value chains mostly involve the terms of contracts and gender dynamics associated with both on and off the sea operations. The middle and lower end value chain actors are mostly concerned about technological changes in market and trade systems. For them, the geographic consideration is mostly about market scoping and value chain integration. These actors look at species intensification from the perspective of demand and price relationships at a system level. All these aspects contribute to the positive and negative feedback loops among the value chain actors at different nodes and segments. For example, Hilsa shad (*Tenualosa ilisha*) is historically one of the most preferred dried fish species in the Indian Bengal Delta. However, it currently stands largely extirpated from the list of dried fish species due to its overfishing in

response to increased market demands and technological advancements (e.g., intensive fishing through the use of advanced gears by trawlers and power boats) (Lauria et al., 2018).

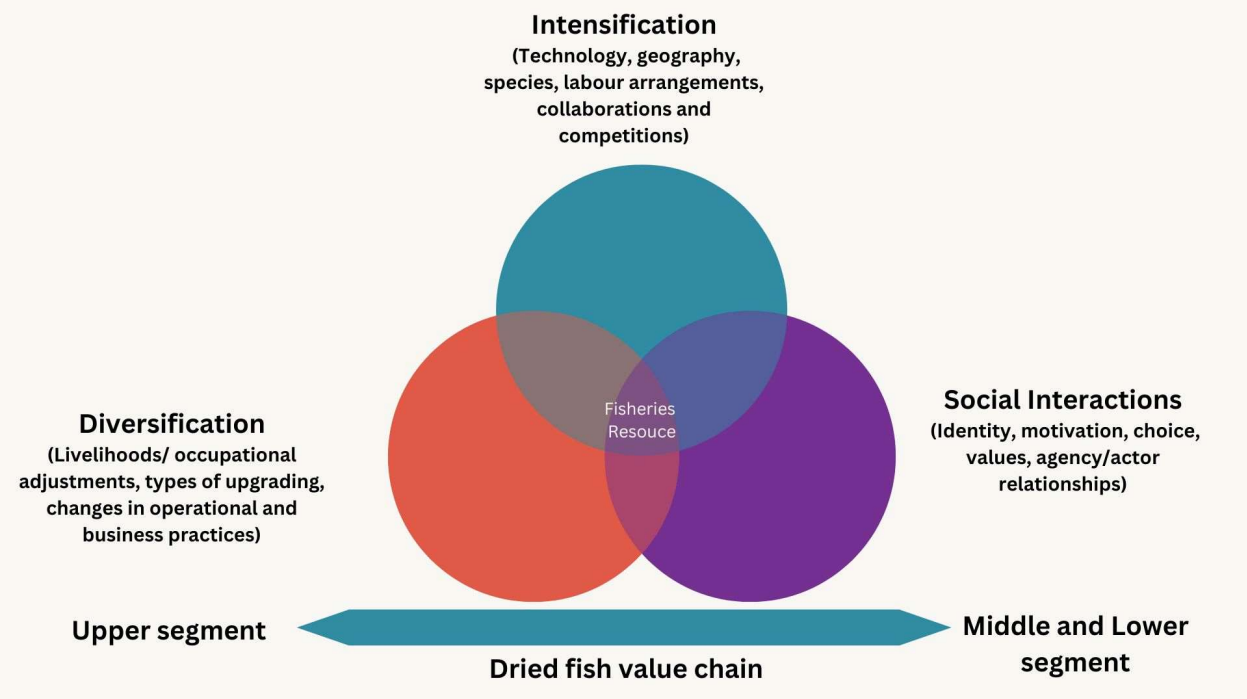

Figure 2.1: Variables and feedbacks in SESDFVC

Second, diversification is related to the ability of the actors to switch across livelihoods options and operating mechanisms that can help to maintain income as environmental, or market changes occur (Finkbeiner, 2015). Diversification can be understood by mapping changes in livelihoods, or in occupational systems that are often influenced by a generalist strategy where the fishers and value chain actors seek multiple options and participate in many activities within the dried fish value chains (see Ellis, 2000, p. 15; Nayak, 2014, 2017; Smith & McKelvey, 1986). The heterogeneous and end-user demands create opportunities for lower end value chain actors to diversify investment opportunities within the sector (Grunert et al., 2005). For example, engagement in the production of dried, fermented, or pickled and frozen fish, fish meal, or poultry feed that uses the same fishing operations could provide various investment opportunities for lower end value chain actors to minimise the risk of investment and enhance profitability. In many parts of India, the growing aquaculture and livestock industries have triggered a growing demand for trash fish (e.g., silverbellies, flatfish, ribbon fish, sciaenids, carangids, and catfish) as animal feed (Funge-Smith, et al., 2005). These demands have intensified commercial extraction of trash and low value fish to cater to the needs of feed industries. In normal circumstances, these

low value fish were available for dried fish processing and for human consumption. In some cases, these changes have pushed the upstream actors to the margins and compelled them to think about alternative livelihoods options with reduced fish production, greater consolidation of catch, and reconfiguration of value chain actors. (Aswathy et al., 2011; Staples & Funge-Smith, 2005). Further, people increasingly opt for coping options, such as temporary migration to nearby cities for wage labour work during the *padia* (low harvest) time of the month based on the lunar calendar.

Third, such diversifications in a market system invite specific transaction costs. In most cases, value chain actors prefer a higher degree of specialisation in catering to the needs of a specific consumer segment (Grunert et al., 2005). While specialization and transaction specific investments offer greater stability to lower end market actors (Grunert et al., 2005), increased specialization of economic activities can increase risks of major system disturbances for fishers and cause higher inequality in the distribution of income (Adger, 2000; Finkbeiner, 2015). With increasing power imbalances in fisheries value chains (Adger, 2000; Béné, 2009; Grunert et al., 2005), fishers and dried fish workers are always at a disadvantage. For example, the booming shrimp market has brought in larger investments and revenue to the shrimp value chain on the east coast of India, and at the same time, it has caused serious disenfranchisement of traditional fishers and women engaged in fish processing activities in the coastal region of Odisha (Nayak, 2014).

Fourth, social interactions and relations are critical determinants of wellbeing and hold higher importance in the value proposition from the perspective of fishers and fish workers (Fabinyi et al., 2014; Johnson, 2017). At the upper segment of the value chains, identity, community values, intergenerational knowledge, skills, social interactions, customary norms and practices, and community agency influence the value chain behaviour significantly (Fabinyi et al., 2014; Jayasinghe & Thomas, 2008; Johnson, 2017). Similarly, trust, response to consumer choice, and community embeddedness of rural entrepreneurs have a stronger bearing on dried fish value chains, which are dependent on supply side variability (Grunert et al., 2005; Jayasinghe & Thomas, 2008). Understanding the interplay of these social factors with the ecological foundations of the value chain is crucial.

2.5.2. Linkages in dried fish value chain

A social-ecological systems view offers nuanced perspectives on sub-systems and cross-scale linkages within and across systems (Berkes, 2002; Berkes et al., 2003; Cash et al., 2006). The managers of small-scale fisheries cannot ignore environmental flows, biodiversity and conservation issues, international trade negotiations, eco-labelling, and international codes of conduct that have strong implications for value chain performance (Adger, 2006; FAO, 2015). Linkages between organizations and agencies develop across levels, in part, because of self-interest (Cash et al., 2006). Dried fish value chains are characterised by different segments and nodes that are positioned across multiple boundaries, and each of these segments and nodes comprises a diversity of structures and functions. Such a layered arrangement of the entire value chain risks becoming dysfunctional if strong cross-scale linkages are not properly facilitated (USAID, 2021).

Critical linkages regarding resources, roles, relationships, rules, and results determine the process of actor collaboration, competition for production, distribution, and consumption of goods and services. On the other hand, the neo-classical framework of value chains subscribes to a command-and-control system with a stronger power asymmetry among the value chain actors. More powerful actors with higher political, economic, and financial power often exploit the value chain benefits in their favour (Adger, 2006; Grunert et al., 2005). In the context of a dried fish value chain, upper segment actors are in a highly disadvantageous position. As such, it is important to identify those linkages that promote a fair distribution of benefits and avoid those that have the potential to undermine trust between stakeholder groups (Adger, 2006). Pro-poor value chains typically involve significant transaction costs that involve negotiations over shared values, objectives, and social interactions. Such costs are often considered a burden on efficiency under neo-classical economic models (see Adger, 2006; Birner & Wittmer, 2004).

Figure 2.2 outlines different variables to explain the role of stronger linkages in SES-oriented dried fish value chains across nodes and segments. First, rules and provisions regarding resource access and trade determine the position of the actors operating in different segments of the value chain, and it reflects relationships among fishers and small fish processors within the wider social system (Ommer et al., 2012). Inadequate policy processes often criminalise poor fishers and the business people involved in input and market supply chains. While the poor occasionally adopt non-recommended practices of fishing for basic survival needs, actors operating at the

lower end of the value chain use the desperation of the poor for selfish profiteering. In this process, both resource systems and poor fishers face double marginalisation due to limited access to security, justice, and political capital (Kleih et al., 2003). For example, in the Bay of Bengal region of eastern India, the prawn / shrimp aquaculture industry has used the poverty of fishers as an opportunity to incentivise and influence their engagement in catching shrimp juveniles and destroying swamps and mangroves (Jana & Jana, 2003). It has adversely affected the dried fish sector due to its primary reliance on artisanal and inshore fishing.

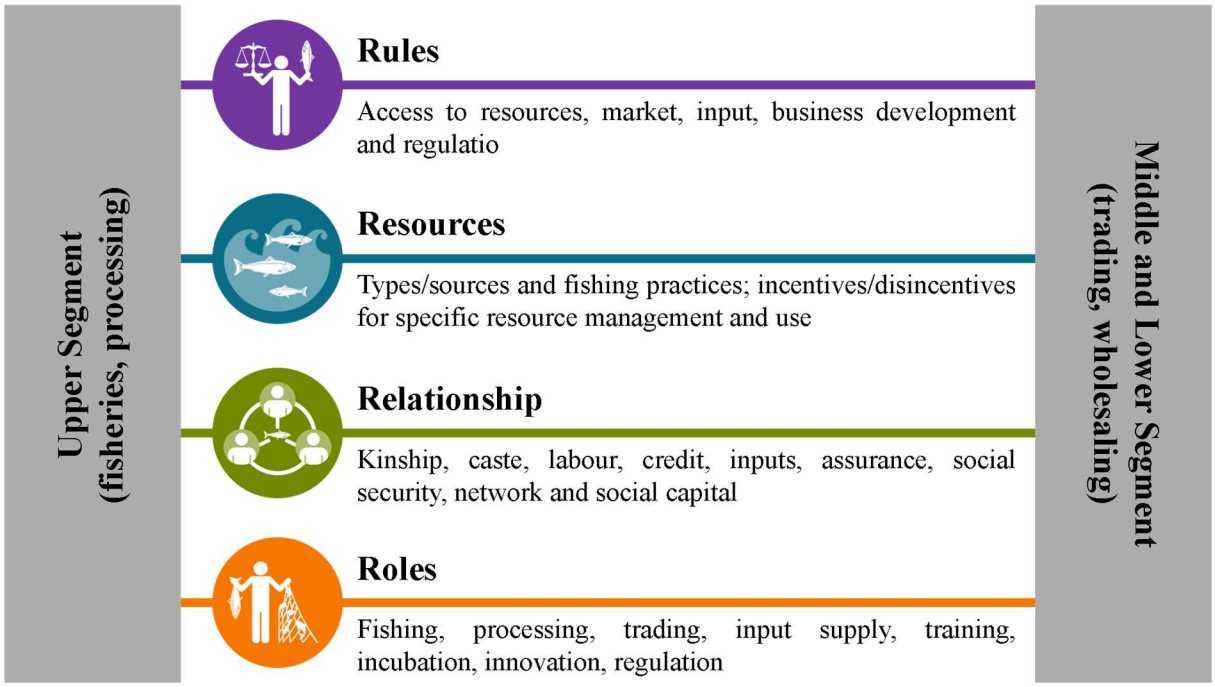

Figure 2. 2: Variables and indicators of Linkages in SESDFVC

Second, the access to resources in terms of catch, credit (Kleih et al., 2003), technology, infrastructure, knowledge (Andrew et al., 2007; B. I. Crona et al., 2015; Stoian et al., 2012) determines the negotiation power of trade actors and influences benefit distribution across chain actors. Therefore, it is critical to understand the resource related linkages among actors in upper, middle, and lower segments of the dried fish value chain. Third, actors' relationships both in terms of material and non-material associations with resources in terms of identity and intergenerational skills determine the wellbeing outcomes for people engaged in upper segments of the value chain (Nayak, 2014). The actor relationships across scales and levels influence value chain behaviours and shape cooperation and competition among actors (B. Crona et al., 2010). For instance, in Naziratek Bangladesh it is found that there is a strong distinction between locals

(fishing communities of southeast Bangladesh) and outsiders (floating population of Chittagong city). Exploitation of labour was legitimated through a variety of discursive practices, often involving identity, access, local knowledge, and connection with local social-ecological systems (Belton et al., 2018).

Fourth, actor roles are a key variable of horizontal and vertical linkages as they determine incentives and disincentives for different actors in the value chain. The specialised nature and knowledge intensive systems of dried fish operations help build linkages with resources and actors though the lower segment actors manipulate the systems using the poverty situation of upper segment actors. In fact, a successful pro-poor value chain relies on linkages among the chain actors and ensures greater social benefits having linkages with associated subsystems like health, education, social protection (USAID, 2021) . Minimisation of entry barriers though appropriate capacity development, incubation support and greater science-practice dialogue are also emphasized (Stoian et al., 2012). For example, a study from Digha coast of West Bengal suggests that in a typical dried fish value chain that involve more than six actors in the chain, the fishers share is about 7.78% of the consumer rupee and the processors margin is about 6.39%. In the same where the chain is short and dried fish processors have greater access to wholesaler without involvement of intermediaries the fisher's share is about 15.8%. The fishers and dried fish producers who have access to market infrastructure, storage and proper drying facilities have fared better in terms of their share in consumer price (Payra et al., 2018).

2.5.3. Uncertainties in dried fish value chains

Uncertainties are inherent in complex systems (Biggs et al., 2015). They pose strong challenges to the governance of social-ecological systems and make it difficult to develop and adopt appropriate economic policies (Levin et al., 2013). In a value chain context, uncertainties are often treated as risks. While risk often has negative outcomes, uncertainties can produce positive results through the emergence of new possibilities (Charles, 1998). Markets perceive uncertainties under three broad categories: (1) organizational uncertainty (product characteristics, production process, decision-making, management control, organizational behaviour); (2) internal supply chain uncertainties (consumer demand, supplier-related issues, inventory issues, infrastructure, and facilities); and (3) external uncertainties (government regulation, competitive behaviour and macro-economic processes, disasters, and natural hazards) (Simangunsong et al., 2012). To manage uncertainties, most of the value chain actors rely on strategies that bring

efficiency to procurement systems through a series of measures, including a price dependent base stock policy, inventory management, and collaborations among the chain agents (Simangunsong et al., 2012). While risk and uncertainty have received strong management attention within a market system that includes value chains, the irreducible and dynamic nature of uncertainties in complex systems has generally not been accounted for in dried fish (or other resource-oriented) value chains.

Uncertainties in fisheries systems can be grouped under three major categories (Fig2.3): (1) random fluctuations; (2) imprecise estimates and surprises by nature; and (3) structural uncertainties (Charles, 1998). Random fluctuations are relatively better managed with a clear understanding of demand and supply variability and process uncertainty related issues. The supply variability is assessed by mapping yield parameters, habitat characters, market fluctuations, preferences, and other possible factors that influence the supply of fish and fish products to market. Demand variability is critical, as it shapes the nature of value chain structure to a great extent (Grunert et al., 2005). In the dried fish system, resource access, enterprise and commerce policies, phytosanitary standards, and sustainability standards hold greater importance. At the same time, consumer preferences are often subject to the variability experienced in their income and access to markets.

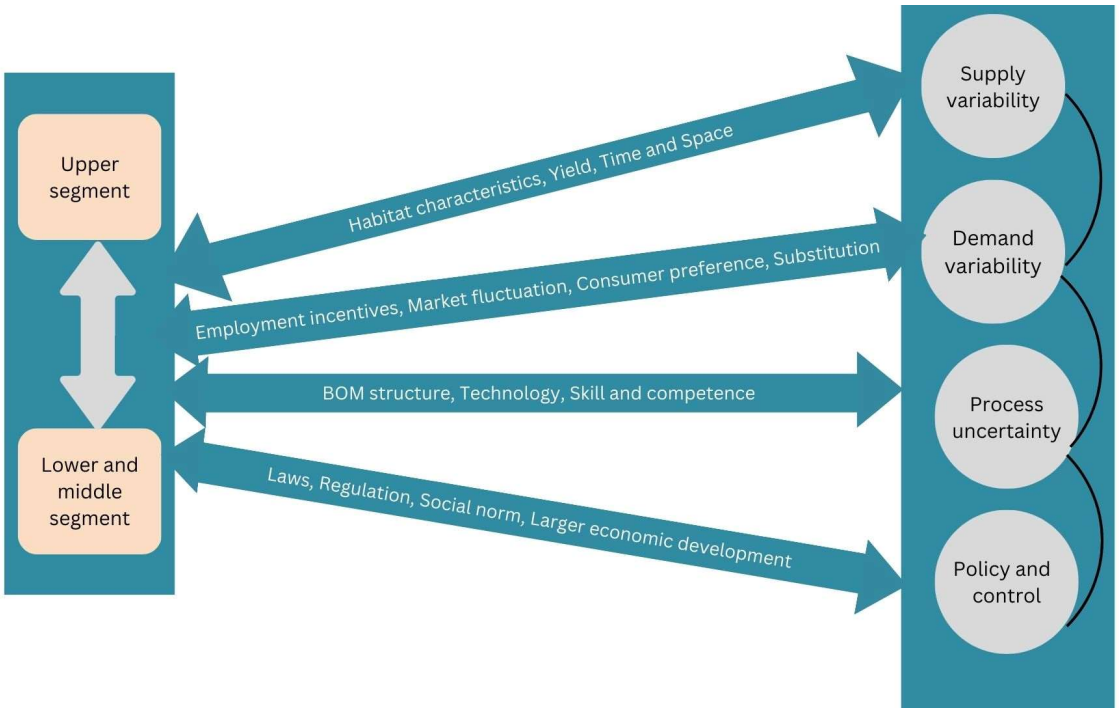

Figure 2. 3:Variables and indicators of uncertainties in SESDFVC

Process uncertainty is particularly prevalent due to strong bill of materials (BoM) structure, whereby, for example, pelagic fish that earlier had limited use options are now greatly in demand due to their growing value (and demand) in fish mill and poultry feed industries. The fast-changing technology, along with the nature of skills and resource access, cause higher levels of uncertainty for actors, particularly in the upper segment of the value chain. Such uncertainties are often dealt with through strategies including scenario planning, which, for example, includes survival rates of species and prices in the market, and inventory management (Larson, 2004; Sethi, 2010). However, it is important to acknowledge that there are stronger interactions between subsystems that influence random fluctuations, and any change in subsystem characteristics will have strong non-linear feedbacks to the whole system (e.g., market, value chain). In a value chain context, actors also need greater clarity on planning and control aspects that include policy matters, societal norms and behaviour, market information systems, and consumer preferences, all of which are responsible for creating opportunities and stress in the value chain operations. Structural uncertainty is most problematic as it reflects challenges in the fishery system (Charles, 1998) that can cause unanticipated change (Holling, 1973, 1978). In a dried fish context, for example, the growing emphasis on culture fisheries under the MKSSY programme in the eastern coast of the Bay of Bengal has resulted in exploitative forms of fishing as the market demand for trash fish for fish meal industries increased many folds. It has not only triggered the use of smaller mesh size nets but also marginalized small, local dried fish processors due to dwindling local catch and the expansion of trade territories with deep sea fishers able to tap distant markets. At the same time, with longer fishing trips undertaken for shrimp and high value fish, it is also seen that the discard is higher as they have limited ability to preserve and dry within the sea. With a greater push and policy incentives on domestic and international exports of high value fish, the low value fish that were earlier used for drying are now also sold as fresh fish (Salagrama, 1998). All these factors have a cumulative impact on the small-scale dried fish processors and fishers in the east coast of India.

In view of this discussion, a SES perspective becomes increasingly useful as it advocates for practical ways to embrace uncertainties in a complex system, instead of avoiding them, as a way to achieve system resilience and sustainability (Nayak and Armitage, 2018; Biggs et al., 2015). This has profound implications for how we conceive a SES-oriented value chain for dried fish. A SES perspective allows for knowledge integration from diverse sources including at the node

level and interactions within whole social-ecological systems, thus, promoting holistic understanding about the functioning of the entire system. A SES perspective enables collaboration without jeopardizing the interests of fishers and dried fish workers and multilevel partnerships between the segment actors that can lead to creative problem-solving in the face of uncertainties (Berkes, 2007; Ommer et al., 2012).

The dried fish subsector is relatively invisible, while fish value chains face multiple challenges from political, economic, and environmental factors, including climate change. Figure 2.3 outlines key variables and indicators derived from fisheries systems and food processing related value chain literatures, and their implications for uncertainty. The supply variability in dried fish value chain setting can be understood by analyzing change in habitat characteristics, yield and market demand. Similarly, indicators such as employment incentive/disincentives, consumer preference, market promotion and product substitution can explain the demand variability of a product. Dried fish systems are characterized by strong process uncertainties, and it can be understood by analyzing its BoM structure, changes in technology in various value chain nodes and associated processes and change in the skill and competence level of people engaged in the sector. The policy and control uncertainty related to laws, regulation, changing social norms and caste dynamics in fisheries and larger economic development processes influences the conduct and performance of the value chain significantly.

2.5.4. Emergent Properties in dried fish value chain

Emergence is defined as the advent of novel properties or functionalities that cannot be anticipated from the knowledge of the parts of the system alone (Centre for Complex Systems Science, 2011; Moore et al., 2018). This novelty is the result of a continuous process in which interactions among and between people and ecosystems generate emergent outcomes that change the context of future human actions and ecosystem dynamics (Schlüter et al., 2019). The relevant literature outlines four key variables that help further our understanding of emergent properties in the context of a SES-oriented dried fish value chain. The variables include spatial features, place-based values and ethos of value chain actors, socio-legal arrangements, and practice and skills (Gereffi et al., 2005; Jayasinghe & Thomas, 2008). Figure 2.4 offers an analytical perspective of variables with regard to upstream, middle, and downstream actors of the value chain.

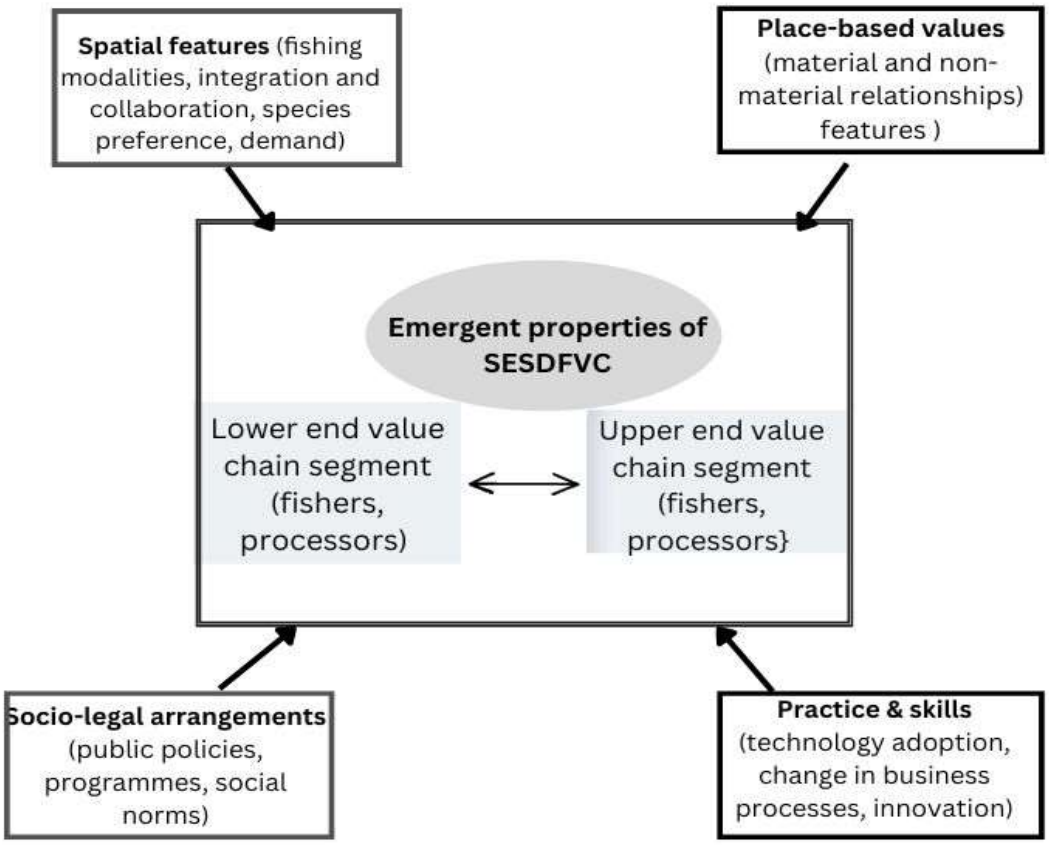

Figure 2.4: Variables and indicators of emergent properties of SESDFVC

Spatial features such as trade demands for specific products, along with processes and practices, shape the behaviour of actors and agencies across the product value chain with respect to resource use and trade practices (Gereffi et al., 2005; Kaplinsky & Morris, 2000). The product specificity in the context of dried fish can be understood as a specific product type, product source, species preference, and enabling trade environment. This is also true in the case of fishers and dried fish workers. For example, the market preference for dried shrimp, unsalted Indian anchovies, golden anchovies, and white mullet from the Odisha coast is higher than in other parts of the country, and similarly, the Bombay duck from the western coast has a stronger market preference. There are also strong interdependencies and exchange mechanisms that exist among the dried fish processors of different regions who specialize in varied species. Such preferences have a stronger influence on value chain operations with respect to catch preference, actor dynamics in fishing, and supply chain interactions.

Studies in small scale fisheries reveal that market drivers often cause rapid change and at times modify the characteristics of social-ecological systems, and the actors engaged in different levels

of the value chain manifest new pathways of engaging with resource and market systems (Nayak & Berkes, 2019). However, the entrenched place-based values and ethos of local fishing communities also influence the interactions with resources and transactions with other value chain actors (Jayasinghe & Thomas, 2008).

At the same time, socio-legal arrangements such as rules, norms and trade terms offer new opportunities for the actors to continuously adapt and innovate in the face of novel and somewhat unexpected outcomes, i.e., emergent properties of the dried fish. For example, due to the increasing emphasis on aquaculture with about 200% enhancement in production during the period 2001 to 2019 in Odisha alone (Ngasotter et al., 2020), the eastern coast of Bay of Bengal has experienced significant changes in the working profile of small-scale fishers. As a result, some fishers who have adequate human resources at home are now buying 'c-class fishes (i.e., pelagic fishes whose shelf life is almost nil and not good for other processing including freezing) from deep sea trawlers and processing those as feed mill. These fishers are also acting as small aggregators at the community level and providing marketing support to other small processors who operates with low volume and can not access the market agents due to higher transportation cost considering the volume of production. They tend to have comparative advantage over other small-scale fishing families as they can operate at a minimum scale with consistent levels of production in the face of dwindling in-shore fish catch owing to competition and extractive fishing practices.

2.6. Towards a social-ecological systems perspective for dried fish value chains

A social-ecological systems perspective with a set of reimagined variables for analyzing value chain structure, conduct, and performance offers a novel outlook on principles and conditions for understanding dried fish value chains. Such a co-evolutionary perspective promotes collaboration and the participation of various stakeholders in value chain decision-making and places more emphasis on interactions with upper segment actors as they are directly linked to resource systems. A social-ecological perspective also places more emphasis on diverse realities and options rather than focusing on linear transactions among actors operating across various nodes of the value chain.

Figure 2.5 provides an initial hybrid and interdisciplinary conceptual framing of a SES-oriented dried fish value chain. The framework includes several novel ideas in terms of its main components and cross-scale interactions. **First,** the framework introduces the resource base or

the fisheries ecosystem as a central and/or novel node in the dried fish value chain. We have discussed above that the absence of resource and ecosystem considerations tends to create a lopsided value chain with significant bias towards economic and market mechanisms. This positioning comes at the cost of excluding the fish and the fishers. The principle that 'if there is no fish (and its habitat) there is no dried fish' will become a reality if we continue to exclude the resource and ecosystem node from the value chain (Jentoft, 2000; Nayak & Berkes, 2011, 2019). The resource node is fundamentally dynamic and that determines the price, product, livelihoods of resource dependent communities and the regulating framework which are critical to the functioning of the value chain. **Second,** the SES value chain perspective places the producing and processing, trading, retailing, and consumer nodes from the conventional value chain along with the new resource and ecosystem node in a two-way feedback relationship. Doing so clarifies that these nodes are bound by multiple interactions across several scales and levels of the entire value chain – that they are in fact 'co-produced.' In tandem with the new resource and ecosystem node, the four conventional nodes help to generate a comprehensive view of the dried fish value chain and a logical sequence in which value chains tend to function effectively. **Third,** the framework reflects a social-ecological system view of the dried fish value chain by organizing nonlinear feedback, dynamic linkages, uncertainties, and emergence as key attributes that guide the node level interactions. **Fourth,** the three segments - structure, conduct and performance - of the value chain remain integral to its core and an active part of the interactive process involving the SES attributes and the five nodes.

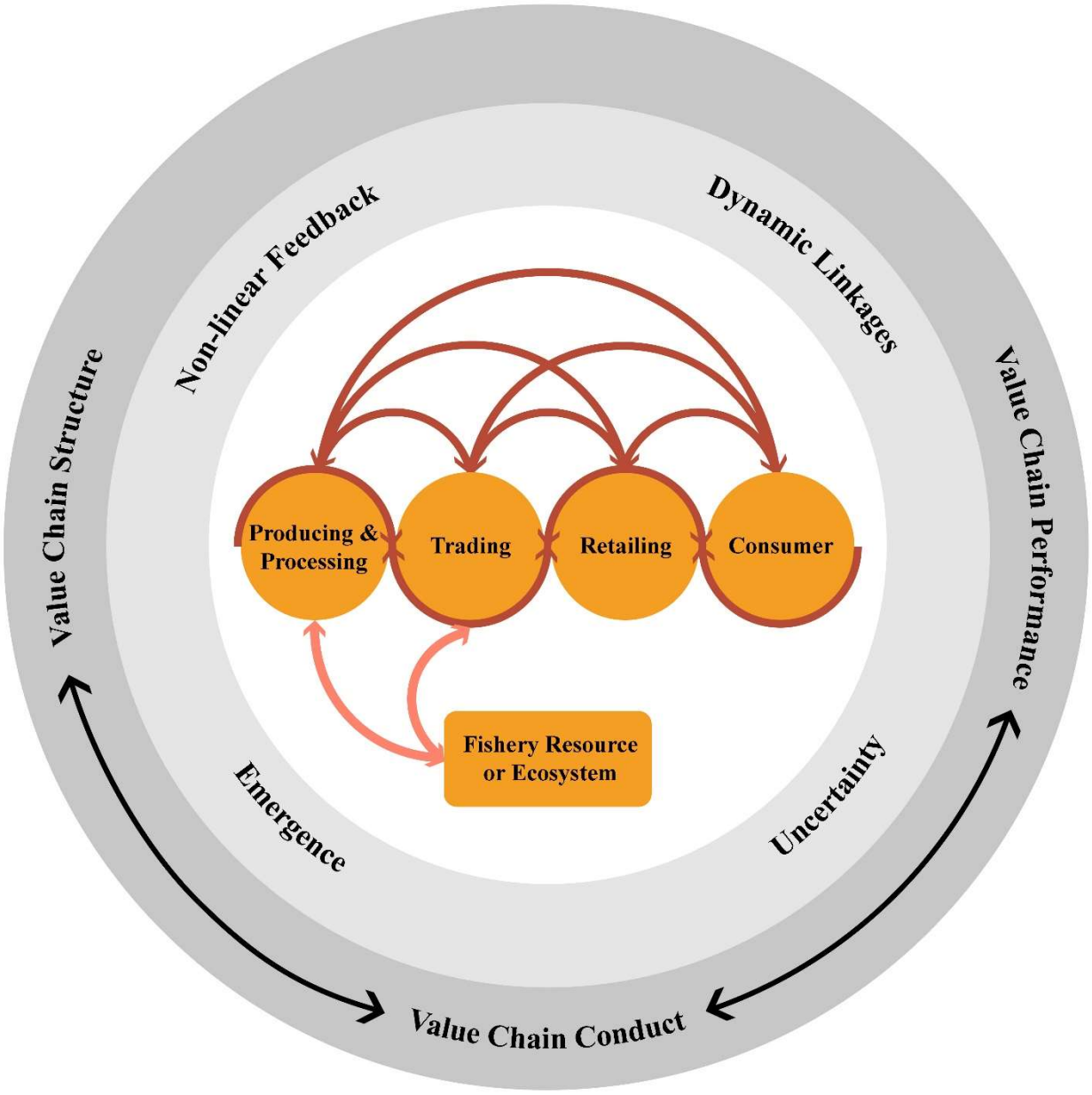

Figure 2. 5:Conceptual framework of SESDFVC

As reflected in Figure 2.5, several configurations of value chain structure exist based on social-ecological system interactions throughout the dried fish value chains. The dynamic interplay of SES attributes, variables, and their expressions vis-a-vis the structure, conduct and performance indicators in the dried fish value chain offer a strong departure from the conventional value chain perspective. Table 2.2 outlines the shifts in key considerations and principles between the conventional economic value chain and social-ecological system-oriented value chain. Notably, a conventional value chain is heavily reliant on technological innovation in relation to time and

distance, and the chain is averse to surprises. In contrast, a SES-oriented dried fish value chain places greater importance on the wellbeing of the resource base and the actors, particularly in the upper segment of the value chain. It considers upstream actors as active collaborators, values the dynamic resource context, and provides new insights for dried fish value chain management.

Table 2.2: Key shifts in SES oriented dried fish value chain dynamics from conventional value chain.

Value chain aspects	Conventional dried fish value chain (VC)	Novel SES-oriented dried fish value chain
Structure	Biophysical resource base is exogenous to value stream and the problem in the resource is treated as externality.	Biophysical resource is critical and internal to value stream in the value chain and considered as an important node in the value chain structure
	Focuses on linear feedback among value chain nodes and actors across value stream in a vertical manner	Places importance on non-linear feedbacks and interaction across the level and scale is dynamic. Horizontal issues are given equal importance.
	Fisher and dried fish workers as passive contributor of input and labour and the weakest economic agent with regard to value chain decision making	Fishers and dried fish workers as active collaborators with contextual knowledge and cultural bound norms. Participatory and gender aspects are critical for VC decision making
Conduct	Market logic (profit)	System logic (social, economic, and ecological)
	Weak connections and interactions between social justice, social wellbeing, and environmental justice	Greater consideration of resource and human connections and subsystem interactions. Equal importance on upstream issues (resource system, fisher, and dried fish workers), identity, food security alongside profit and revenue gain.
	Value Chain efficiency is seen as the aggregate value creation across node. Techno-managerial changes are determined through profit points irrespective of value chain segments	Performance is critical within and among subsystem of value chain (nodes and segments). Upstream (resource and fishers) aspects are critical for SES oriented dried fish value chain.
Performance	Revenue gain as designed feature	Three-dimensional wellbeing could both be a

	determine value chain performance	process and outcome determinant of value chain performance
	Inbound logistics are determined by technological innovation in relation to durability and distance.	Alive to uncertainties emanating from changes in environment and market processes. Socially and ecologically acceptable criteria holds importance.
	Averse to surprise and new changes. Diversification and technological innovation for controlled flow of inputs and revenue flow	Encourage emergence. Competitive advantage is seized by being culturally, ecologically, and socially relevant
	Lack of importance to CCRF by lower end value chain actors with greater importance on price, convenience, and healthiness of the product.	CCRF compliance with fair distribution of benefits and provides for welfare, freedom, social justice, and sustainability of fisheries.

2.7. Conclusions

Conventional value chains do not effectively capture resource dynamics and relationships with the upstream value chain actors. Critical dimensions of equity and wellbeing on poor fishers, small-scale dried fish processors and workers across the value chain are also not always captured, especially as they are directly linked to the ecological foundations of the value chains. In contrast, a social-ecological systems perspective on value chains encourages consideration of multiple realities and linked understandings of the social, cultural, and economic implications over time and space. Further, an SES-oriented value chain treats the bio-physical resource as an important node, and it considers the upper segment actors (fishers and dried fish workers) as active collaborators rather than passive contributors to the dried fish value chain. SES-oriented value chain analysis also offers additional perspectives for the scholarship on pro-poor value chains where the role of the primary producer and fair distribution of benefits in favors of upstream actors is critical.

Further, our analysis considers "value" as reflective of material, relational and subjective dimensions of upstream actors instead of a mere economic construct as envisaged in the extant value chain that adheres more closely with neoclassical perspectives. There is a greater scope for

analysis of value as human wellbeing in SES-oriented value chains. Interventions to enhance value chain outcomes will be better informed on the resource and market dynamics and uncertainties by having information about social-ecological context and diverse realities. Such information will help to address value chain challenges without losing sight of the interest of poor fishers and inform the core value chain design processes beyond risk analysis.

Chapter III

Mapping Social-Ecological-Oriented Dried Fish Value Chain: Evidence from Coastal Communities of Odisha and West Bengal in India

3.1. Abstract

The production and trade of dried fish are important sources of livelihoods and employment for poor people engaged in the dried fish value chain. More importantly, half of them are women. Dried fish makes a significant contribution to the food and nutrition security of the poor because it is high in calcium and other vital micronutrients. Despite its importance, work on the dried fish value chain (DFVC) continues to focus on financial value creation and linear interactions among market actors that impede the recognition of human rights, justice, food security, and power across the entire value chain. Such a neoclassical perspective on DFVC tends to undermine the complex human-nature interactions that are contingent upon specific histories, people, places, and practices (Pradhan et al., 2022). Poor fishers and dried fish processors placed at the extractive end of the value chain hold low power in the market and remain vulnerable to changing social-ecological system dynamics. The chapter through a mixed methods research framework, provides an empirical outlook of the dried fish value chain in relation to SES attributes in the context of the eastern Indian coast of the Bay of Bengal, including Odisha and West Bengal. The chapter maps out the dried fish value chain in the case study context and provide an empirical analysis of attributes of social-ecological system oriented dried fish value chain (SESDFVC). The attribute level analysis maps the social, economic, and ecological interactions, multiple non-linear feedback loops among actors and value chain nodes, offering a comprehensive understanding of place-based and actor-based issues in a disaggregated manner. SESDFVC values dynamic resource contexts, considers upstream actors as active collaborators, and expands the notion of value to include the social-ecological wellbeing of the value chain actors.

Key words: Dried fish, Social-ecological system, Social-ecological wellbeing, Value chain,

3.2. Introduction

Dried fish as a subsector of small-scale fisheries (SSF) has received little academic and policy attention despite its significant contributions to the nutritional and social wellbeing of the poor

(Belton et al., 2022; Thilsted et al., 2014). Dried fish is an important source of livelihoods, income, and employment for millions of people engaged in fishing activities. More importantly, half of them are women. Drying fish is one of the oldest methods of fish processing (Vidaček & Janči, 2016). The livelihood contribution of dried fish production and trade is immensely important for low-income consumers (Belton et al., 2022, p. 220; Johnson, 2017). In maritime eastern Indian states like Odisha and West Bengal, the dried fish production is higher than all of India's average. While 6.32% of the total fish catch in Odisha is used for drying, the corresponding data for West Bengal is 6%. However, the share of dried fish in the marine fish catch is relatively high. For example, in Odisha it is about 15% (GoI, 2020).

Current research on the dried fish value chain (DFVC) continues to focus on financial value creation and linear interactions among market actors. However, such an approach impedes the realization of human rights, justice, food security, and power distribution and sharing across the entire value chain. Such a neoclassical perspective on DFVC tends to undermine the complex human-nature interactions that are contingent upon specific histories, people, places, and practices (Pradhan et al., 2022). It places the poor and vulnerable fishers and small-scale processors at the upper segment of the value chain, marginalizing them in value chain decision making. Globally, the low level of power holding in the market along with dwindling fish stocks is leading to growing concerns about the continued viability of SSF and dried fish communities.

The trade and technology focus in value chain interactions have altered the dynamics of SSF with growing attention to culture fisheries, commercial fishing, and the marketing of frozen and live fish. In recent years, in India, there has been a sharp rise in the production of inland fisheries by a cumulative annual growth rate (CAGR) of about 8.57%. Over the last decade, the production from marine fisheries has remained almost constant with a marginal increase in CAGR of 1.53%. The share of the dried fish trade is 4.27%, with a negligible change of 2.6% in CAGR in the marine, brackish water, and inland sectors over the last decade (GoI, 2014, 2020). The CAGR of the frozen and live fish trades has grown by 9.66% and 4.56%, respectively, in terms of their volumes. Over the last decade, the export of the fisheries sector in India has been dominated by frozen fish, with a CAGR of 17.61% in terms of quantity and a CAGR of 16.26% in terms of value over the last one decade. The corresponding figures for dried fish are 0.73% and -4.4%, respectively (GoI, 2014, 2020). These figures reflect that the driving factor of the

SSF value chain is to gain a competitive advantage in the global commodity market and readjust the production systems accordingly (Kaplinsky & Morris, 2000).

A social-ecological system oriented dried fish value chain (SESDFVC) was recently proposed by Pradhan et al. (2022). The SESDFVC framework underpins multiple realities and links to our understanding of the social, cultural, and economic dynamics and implications of the value chain over time and space. The framework considers fisheries resources as a critical node rather than an enabler of the inbound logistics function of the value chain. Such reconfiguration of value chain nodes helps to elevate the role of upper segment actors [fishers and small dried fish processors] as active collaborators rather than passive contributors to the DFVC (Pradhan et al., 2022). In light of the above backdrop, the chapter provides an empirical analysis of dried fish value chain operations and examine the attributes if social-ecological system oriented dried fish value chain (SESDFVC) in the case study context.

3.3. The Conceptual Foundation of SESDFVC

Value chain analysis offers a progressive approach to explain trade barriers for the poor. Such analysis catalyzes an understanding of multi-layered interactions and economic exchanges between actors in various market nodes and systematic competitiveness across scales (Gereffi et al., 2005; Kaplinsky & Morris, 2000). A value chain is governed by a notion of circulation (i.e., exchange relations and the politics of buying and selling) among economic agents and the distribution of financial benefits across those agents in the chain (Attaie & Fourcadet, 2003). Interdisciplinary scholars have contested such a neo-classical economic perspective that singularly considers natural resources as commodities (Fabinyi et al., 2018; Johnson, 2017; Nayak & Berkes, 2011). In the case of dried fish, the interactions within the value chain and with resource systems are quite dynamic. The resource system refers to the ecological resource base that is comprised of multiple resource units and multitier users (Ostrom, 2007). For this paper, we posit coastal fisheries as the resource system.

Fishing and fish processing practices are characterized by strong social norms, kinship, and other unique relationship networks with context specificities that are inherently varied (Johnson, 2017). Fisheries embody multiple social and ecological processes, dynamics, and relationships (Adger, 2006; Jentoft, 2000; Pradhan et al., 2022). The complex relationship in a DFVC is manifested by the competing interests of economic agents operating in different value chain nodes. The price, convenience, quality of product is of particular interest to lower end value

chain actors including traders, retailers, and consumers. Their concerns for environmental sustainability and wellbeing of the fishing community are low and the quest for high value sea food products often cause social-ecological disruptions (Belton et al., 2018; Ferguson et al., 2022; Pradhan et al., 2022). The upper end value chain actors (fishers, small curers, and dried fish workers) are often challenged with factors like lack of quality measures, improper market information, and lack of power in the market (De Silva, 2011; Schuurhuizen et al., 2006). The lack of trade investment in both fishing and fish processing is accentuating the problem with overfishing, loss of traditional jobs and added value for the local population (Schuurhuizen et al., 2006). There is documented evidence of the relationship between resources and resource communities and their connections with all subsystems at different scales and levels (Berkes et al., 2003; Nayak & Armitage, 2018). Sustainability science also recognizes the importance of interactions among resources and resource dependent systems (Kates et al., 2005; Nayak et al., 2014)

In contrast to the economic value chain analysis, SESDFVC helps to analyse value chain structure and enables to conduct and performance considering the concerns of fishers and small-scale dried fish processors at the upper segment of DFVC (Pradhan et al., 2022). The value chain segment signifies distribution of the actors based on their role in the chain. Two segments, viz., the upper segment (fishers, small processors, and dried fish workers), and the lower segment (larger processors, traders, wholesalers, and retailers), are relevant to the present study. The actors in the upper segment often have mixed identities, with overlapping roles as fishers, dried fish processors, and even the local traders. The SESDFVC recognizes the fishing resource system as a critical node in the value chain that has stronger cross-scale feedback across the chain actors (Pradhan et al., 2022). If the fisheries system is not included as a key node in DFVC, it can lead to a skewed view that favours economic and market mechanism and makes it difficult to consider “value” in ways other than money. The principle "if there is no fish, there is no dried fish" becomes a reality if the fishery ecosystem is placed outside the value chain nodes as an enabler for provisioning of raw materials (Jentoft, 2000; Nayak & Berkes, 2011, 2019). SESDFVC perceives the value chain structure, conduct and performance in a two-way dynamic relationship. It includes the resource system and helps redefine value chain conduct with social-ecological systems attributes. The interplay between value chain structure and conduct helps in

reimaging value chain performance as social-ecological wellbeing of upper segment actors which is beyond revenue gains across value chain nodes (Pradhan et al.,2022).

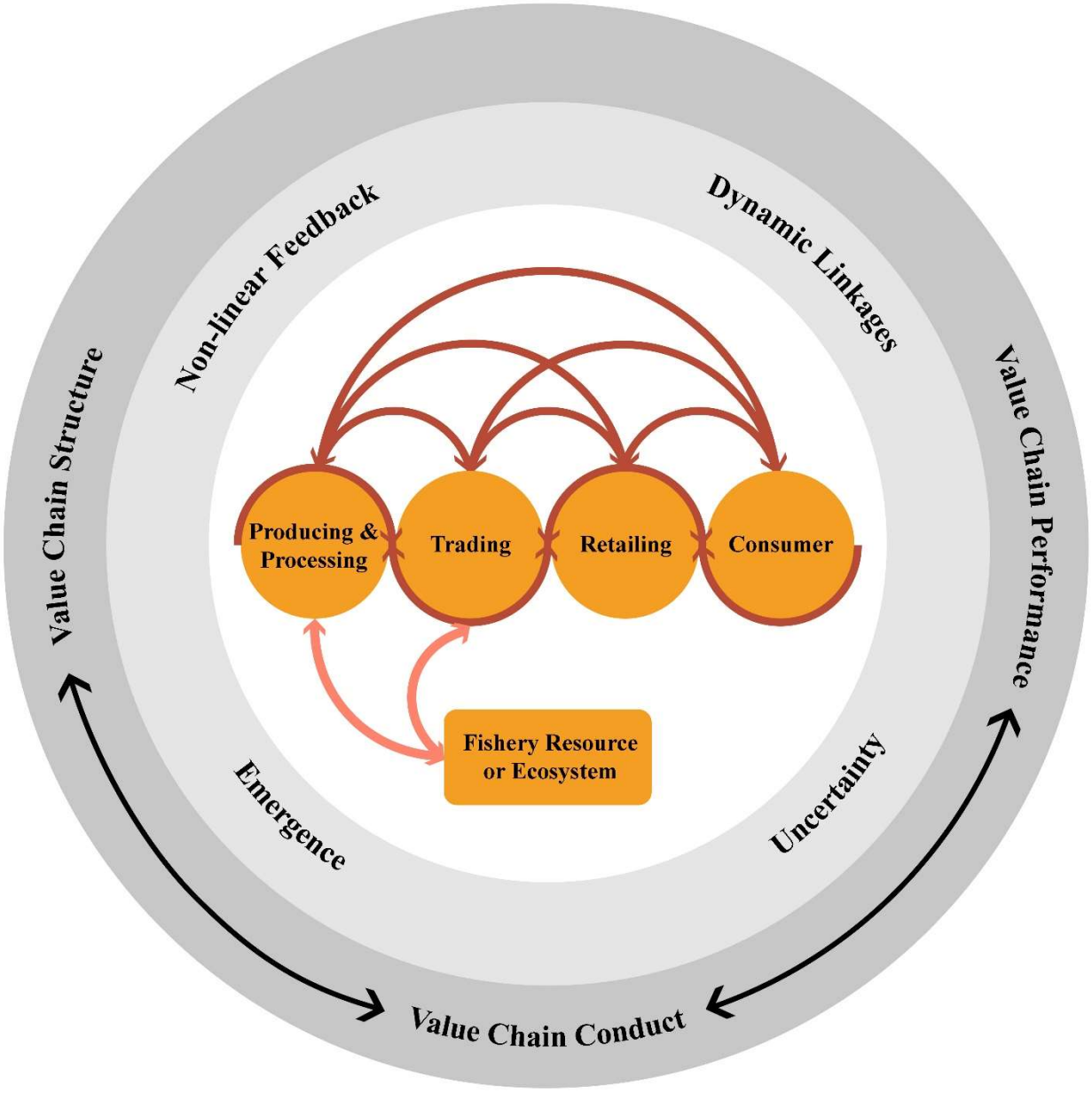

Figure 3.1: SESDFVC conceptual framework (Pradhan et al., 2022: 43)

Analysis of SES attributes (fig. 3.1) such as feedbacks, linkages, uncertainties, and emergence with a clear understanding of subsystems and different parameters associated with these attributes offers a novel perspective that has stronger conformity to an inclusive value chain perspective (Pradhan et al., 2022). An inclusive value-chain approach calls for a consideration of equity issues without ignoring competitiveness. The desired outcome of such an approach

typically manifests as higher earnings and participation of the vulnerable and poor in the value chain process (Haggblade et al., 2012)

The resource node is a dynamic entity as it determines essential value chain processes, including the price, product, livelihoods of resource dependent communities, and the regulatory frameworks (Pradhan et al., 2022). The SES attributes of nonlinear feedback, dynamic linkages, uncertainties, and emergence provide a comprehensive understanding of both horizontal and vertical interactions across value chain nodes. The dynamic interplay of SES attributes, variables, and their expressions vis-a-vis the structure, conduct, and performance indicators in the DFVC offers a strong departure from the conventional value chain perspective. Examination of the human and natural system feedbacks in dried fish operations using variables like intensification, diversification, and social interactions is needed here. These variables offer a nuanced understanding of primary and secondary feedback loops often observed in small scale fisheries value chains (Berkes & Ross, 2016; Binder et al., 2013; Cash et al., 2006; Kooiman et al., 2005; Nayak & Berkes, 2011; Pradhan et al., 2022; Sundkvist et al., 2005). The linkages are understood by analyzing the dynamic interplay of rules, resources, relationships, and roles of value chain actors that determine the process of collaboration and competition for production, distribution, and consumption of goods and services. An understanding of the ecological product value chain is incomplete without considering the aspect of uncertainties in terms of random fluctuations, surprises by nature and structural uncertainties emanating from governance and environmental factors.

The SES-oriented dried fish systems are understood by analyzing the variables, including demand variability, supply variability, and process uncertainties, Uncertainties are seen as inherent system attribute of the value chain (Biggs et al., 2015), which creates opportunity for innovation and new equilibrium. The SES-oriented value chain offers a different management possibility than the typical risk management framework, which deals with efficiency parameters like base stock policy, inventory management, and forging collaborations (Pradhan et al., 2022; Simangunsong et al., 2012). In complex systems like DFVC continuous human-nature interactions result in emergences. Emergence is understood as the advent of novel properties that cannot be anticipated from the knowledge of the parts of the systems alone (Moore et al., 2018; Sawyer & Sawyer, 2005). Such novel properties are critical for value chain analysis to make it adaptive, resilient and have a competitive advantage in terms of being culturally, ecologically,

and socially relevant. All these variables not only influence the vertical interactions in the value stream, but also help in building a nuanced understanding of horizontal interactions in each node of the value stream.

3.4. Research methods and study locations

We used a systematic scoping literature review instead of full-scale systematic review due to dearth of academic literature on dried fish value chain. A scoping review allows for mapping the essential concepts underpinning a study topic as well as the main source and categories of data available (Arksey & O'malley, 2005; Cresswell & Cresswell, 2017). The search was guided by two broad considerations that include (a) SES attributes of value chains (dried fish, food value chains) and (b) wellbeing perspectives of fishers and small-scale dried fish processors. A total of 72 peer-reviewed papers were assessed along with other relevant literature and applied sources of information.

Field research was implemented through a case study approach. The case study provides a scope for a comprehensive, holistic, and in-depth investigation of a complex phenomenon within its context, having a stronger participants' perspective (Creswell & Creswell, 2017; Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014) The case study approach helped to examine the "real world setting" of DFVC on the eastern coast of the Bay of Bengal, India, where the boundary between issues, actors, and contexts is relatively unclear (Yin, 2014). Further, case study research approach was helpful in accommodating both qualitative and quantitative methods and could provide better insights into the how and why questions of the research (Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014).

Considering the emerging constraints of the COVID-19 pandemic, the case study sites were strategically decided to have had strong interactions in both Odisha and West Bengal in terms of dried fish operations (fig 3.2). Both sites have varied social-ecological characteristics. The first site is in the Jagatsinghpur district near the Bhitarkanika Marine National Park. The site has unique features as it has a large estuarine area that is highly significant for conservation with strong floral and faunal diversity (Padhan, 2020). The study site is a habitat for IUCN red list species like sea turtles, crocodiles, and rare species of white crocodile, besides having a rich mangrove forest. Sociologically, the area is also quite dynamic with a large influx of Bengali fishers, who have permanently migrated from the neighboring state of West Bengal and Bangladesh. The people who have migrated from Bangladesh are mostly second time migrants.

First, they settled in West Bengal and then moved to Odisha from there. Except for two households, all the families have permanent residence on the study site and have electoral identity. Only four families are early settlers who belong to the Odia community, and they hold the political and social power in the village.

The second site is NM Padia village, which is about 10 kms from the Digha border of West Bengal. Though the site belongs to Odisha, fishing and trade relationships are mostly with the Digha-Mohana market. The people here are permanent settlers and belong to a fishing caste. They practice in-shore fishing and also work as crew members on West Bengal trawlers operating through Digha-Mohana fishing dock. These communities have adopted drying practices from West Bengal fishers who used to visit and stay for about 5 months in a year; they have been engaged in drying operations. With repeated natural calamities and growing interstate fishing vigilance, the annual migration from West Bengal has stopped and the local fishers have started the drying practice. The area is experiencing strong expansion of culture fisheries with the regular intrusion of West Bengal trawlers into the artisanal fishing area earmarked for artisanal fishers of Odisha.

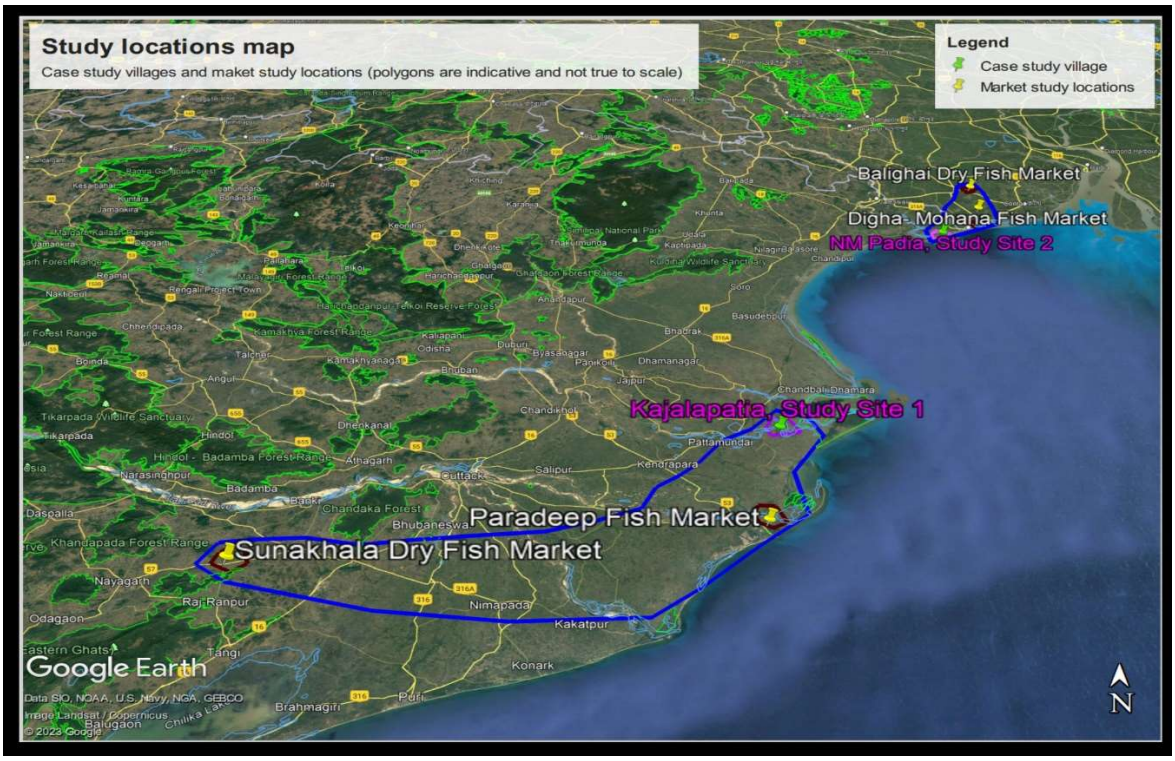

Figure 3.2: Map of study location and case study sites; [**Source:** Google Earth Pro version 7.3.6.9345, (December 2022). Bay of Bengal Cost. http://www.google earthpro.com (27 January 2023)]

We have combined the village survey method with semi structured interviews with actors operating in fishing, processing, and trading nodes. The village survey provided key information about demographic composition, community level institutions, interaction of fisheries, gender roles in fisheries operation, processing, and trading of fish in general and dried fish in particular. The semi-structured interviews provided an in-depth understanding of the social, economic, and ecological interactions of specific value chain actors in the value stream. Along with primary data, an extensive literature review, including the literature on value chains, small scale fisheries, DFVC, SES, and wellbeing, helped in building the conceptual and analytical framework of the research. Secondary data were also obtained from the Department of Fisheries and other government departments to collect their published reports (e.g., Government of Odisha and Government of India).

The village household survey covered 110 households from both the study sites; a fisher household was considered the primary sampling unit. Fishing being considered as the new critical node in the SESDFVC, we have taken 20 samples of fisher households from each fishing community, which is marginally above 30% of the total number of fisher families in the village. From the processing node, we have taken 10 samples from each site, and from the trading and wholesaling node, we have taken eight samples covering both sites. The village survey provided critical information about actors and segments of the value chain. From each of the actors in the dried fish value chain, we randomly selected the respondents for semi-structured interviews. The information obtained from the semi-structured interviews with fishers and dried fish processors helped the select respondents from other segments using the snowball sampling method.

In addition, secondary data used in this study were obtained from published and unpublished sources. Unpublished sources mainly include fisheries department statistics, outcome budgets and mandi records. The published sources include fisheries handbook, websites of national disaster management authority, state disaster management authority, Central marine fisheries research institute, Central Institute of Fisheries Technology (CIFT), Marine Products Export Development Agency (MPEDA) Department of fisheries and animal resources of the

Government of India, Government of Odisha, and Government of West Bengal. The analysis is done by combining qualitative coding and descriptive statistics with the help of SPSS software.

3.5. Results and Discussion

The results section maps out the dried fish value chain in the study region and empirically analyze the attributes of SESDFVC with a greater attention to the wellbeing of fishers, small-scale dried fish processors. Odisha and West Bengal are two critical maritime states of India. Odisha is the fourth largest fish producing state with a production of 816,000 metric tons of fish that constitutes 6% of the India's fish production (GoO, 2021). West Bengal ranks 2nd with 17.82 million tons of fish production. The decadal trend shows that while the marine production is more or less constant, the inland fisheries has registered about 161% growth during the same period in Odisha and 42% growth in Wet Bengal (GoI, 2020). Fish is an integral part of diets of the local communities of these two states. While there is a higher consumer preference on fresh water and live fish, about 6.3% of fish is used as dried fish in Odisha and 6% in West Bengal (GoI, 2020). There is wide variability in terms of choice of species for drying.

3.5.1. Characteristics of dried fish operation

Low-value fishes are caught and processed by small-scale operators, working in labor intensive, mostly self-employed enterprises (Béné, 2009; FAO, 2002). The key characteristics of SSF and dried fish operations in the study sites are presented in Table 3.1. While Kajalapatia, Jagatsighpur (site-1) is more ecologically diverse and has a greater degree of vulnerabilities emanating from social, economic, and governance factors, NM Padia (site 2) offers an interesting picture of the transition from the artisanal sector to the motorized sector with a greater interplay of inter-state actors and processes (Table 3.1). From a social and economic perspective, site 1 provides a weak societal position, with 96% of migrated communities having different linguistic identities, a lack of access to land and resources, and a relatively weak integration into local social-cultural processes. In contrast, site 2 offers a different picture of caste-based identity, permanent settlement, and having stronger interactions with the social and political processes of the region. However, the common issues of both sites are wide-spread poverty, a lack of access to capital, and recurring losses due to the frequent extreme weather events, including cyclones and severe depressions.

Table 3.1: Key characteristics of study location

	Site 1: Kajalpatia and Batighar	Site 2: NM Padia
Fishing area	Estuarine fishing and artisanal area fishing.	On shore fishing.
	Only 5.7% of fishers fish beyond artisanal area.	Only 37% of people fish beyond artisanal area.
Fishing Crafts	7% use traditional boats (canoes with external motors of less than 2HP capacity). 90% use motorized boats (less than 8.5 meter). 3% use Sona boats.	10% use traditional boats (canoes with external motor of less than 2 HP capacity). 53% use motorized boats (less than 8.5 meter). 37% use motorised boats above 8.5 meters length.
Traditional norms and practices	Uthia and padia fishing. Mutual respect to fishing area in the Mahanadi river mouth accessed by the member communities of Kharinasi boat association.	Uthia and padia fishing.
Actor roles	Mixed identity ((assuming multiple roles as fishers, dried fish processors, agreegators).	Mixed identity and specialized operators with specific business portfolio (fish mill, animal feed trader, dried fish trader, fish pickle and fish oil trader.
Time of fishing trips	89% fishers go for one day fishing trips.	35% fishers go for one day fishing trips.
Social relations	79% of the fishers and small-scale processors are migrated from West Bengal and Bangladesh. Lack of permanent land tenure. Low political power. Intergenerational knowledge and practice of fish drying.	Permanent habitations with caste identity. Active participation in the local political process. Greater market access having interaction with both Odisha and West Bengal markets. Acquired knowledge of fish drying.
Workforce	90% boat owners have hired crew	50% boat owners have hired crew

dynamics	from same communities. Shared fishing boats. Annual contract for boat drivers. Monthly contract for other crew members. Shared labour for processing. 89% of processors employ hired labour. 5% are self-employed enterprises.	from same communities. Shared fishing boats. Annual contract for boat drivers. Monthly contract for other crew members. Shared labour for processing. 47% of processors employ hired labour. 53% are self-employed enterprises.
Work division	Male members do fishing, female members engaged in fishing, processing, and selling.	Male members do fishing. Women does processing. Men and women participate in selling.
Fish Production trend	Production has marginally increased, but share of artisanal fishing is declining.	Production has increased but share of artisanal fishing is declining.
Production of preferred dried fish species	High catch unpredictability of preferred species. Competition of space by mechanized and power boats with motorized and non-motorized boats. 'C' class species availability for dried fish processors from the trawlers is inconsistent. Higher prevalence of household based self-employed processing units.	Decline in catch of dried fish species.
Weather vulnerability	Increased frequency of weather events including floods, cyclone, and depressions.	Weather events causing severe damages to processing infrastructure like drying racks, curing tanks, nets, and boats etc.
Policy induced vulnerabilities	Restriction of marine protected area and sea turtle conservation along with monsoon fishing ban (7months) causing long lean season for fish availability for drying. The season advantage is lost.	Growing emphasis on aquaculture changing labour and catch dynamics for inshore fishing.

3.5.2. Steps in dried fish value chain operations

Dried fish value chain operations consist of six steps (Figure 3.3). The first step in the drying process is to either catch or obtain suitable species. The second step is the cleaning of the stock, which is followed by sorting fish as they typically get mixed stock of different species. The third step involves curing in the salt tank. Depending on the size of the processing unit, tank size varies from 100-liters to 1000-liters capacity. Since there is a strong demand for unsalted dried fish, a few species like Indian anchovy, prawns, and flat fish are dried unsalted. Though in small quantities, the larger fish like Hilsa, Snappers, and Silver mullet involve a complex process of intestine removal and salt application. The next step is drying. Smaller fishes are sun-dried on the drying floor, and the midsize fishes like Bombay duck, Eel, and Indian mackerel are dried on the bamboo rack. Processors with higher capacities have opted for permanent infrastructure like cemented floors and bamboo racks, as well as bigger salting tanks. The tiny fish are being dried on the used fishing nets and directly on the ground. Access to land is one of the determining factors for having the necessary infrastructure for drying. The drying period and drying types are subject to the type of species being dried. Bigger fish treated with salt are sold in semi-dried condition, whereas other small and medium-sized fish are sold in fully dried condition.

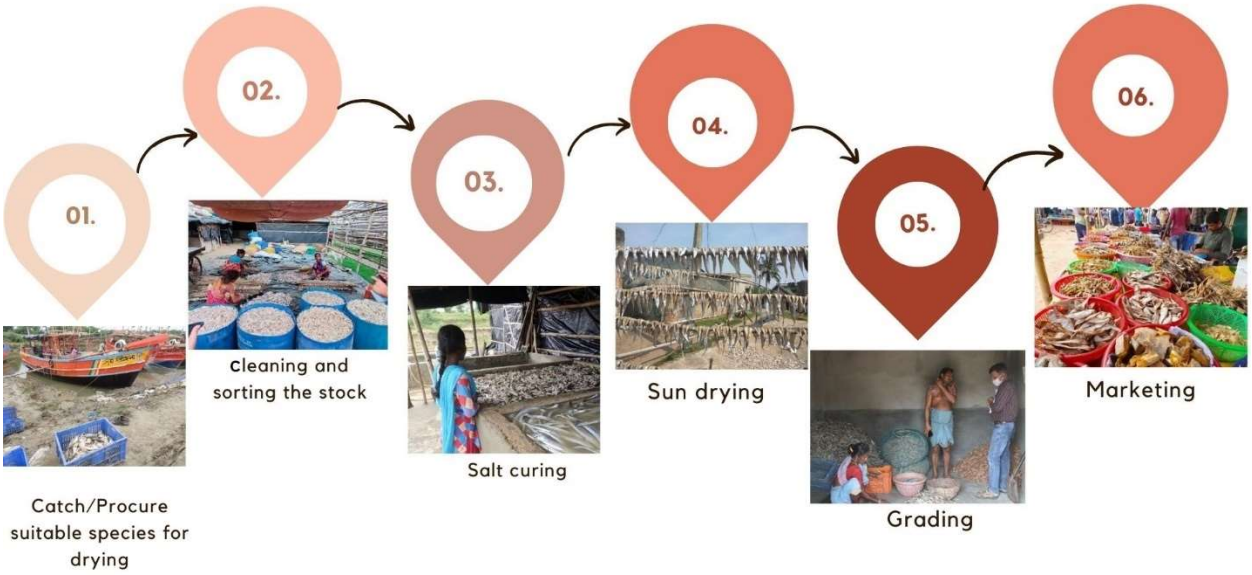

Figure 3.3: Process steps involved in the dried fish value chain in the study location.

The fifth step involves grading the fish. Grading is performed either at the processing point or at the *paikar's* (market agents') point. It is done according to the size and colour of the fish. Ninety percent of the respondents emphasized that there is a positive colour, price, and market correlation. It helps not only in fetching differential prices but also in targeting different rural, urban, and international markets. Though most of the processors have denied the application of pesticides while drying, during the study it was observed that relatively larger processors were using pesticides to avoid damage through pest infestation and also to get rid of flies, which are the main source of faecal contamination. Finally, the product moves from the processors to market agents and actors further down the chain, including traders, wholesalers, and retailers.

3.5.3: Dried fish value chain structure

The dried fish value chain is quite complex in terms of exchange relations, networks, and product movements. In the Kajalapatia and Batighar (site 1) regions, the DFVC is strongly characterized by self-employed household enterprises run with their own labour and catch, and small dried fish units operationalized through household and hired labour. During the lean fishing period, besides their own catch, they buy "c" class fish from Nehru Bangala and Paradeep through auction. Based on the species, the price is negotiated. It varies from $0.14 (INR 10/-per kg) to $0.80 (INR 60/-per kg). They process it at their facility and generally, after drying, the weight reduction is to the tune of 50 to 70%, depending on the type of fish. For example, raw chauli (Indian anchovy) fish is purchased for $0.28 (INR 20/-) to $0.55 (INR 40/-) per kg and dried fish is sold for $0.55 (INR 40/-) to $2.40 (INR 180/-). The small shrimp are purchased for $0.28 (INR 20/-) to $0.80 (INR 60/-) and the dried shrimp are sold for $1.25 (@INR 100/-) to $2.50 (Rs 200/-) by the processors.

As shown in Figure 3.4, the dried fish moves through different means to the wholesale market and reaches the retail chain. A small portion of the dried fish that meets international quality standard specifications is procured by exporters in Odisha and West Bengal. Exporters have their own commission agents and wholesalers who supply by performing additional grading at their end. Few exporters also procure directly from processing units with appropriate standard specifications. It is also found that there is a stronger connection between lower end value chain actors in terms of product procurement and marketing across Odisha, West Bengal, the North-eastern states, and Andhra Pradesh.

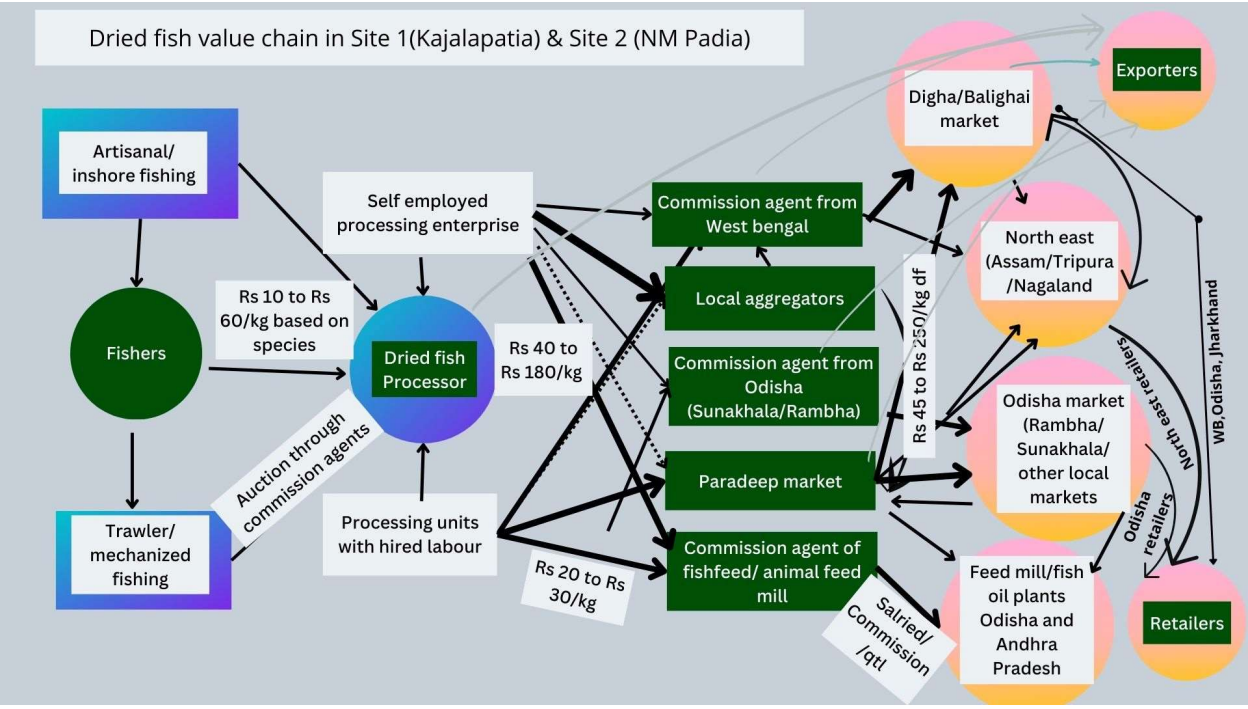

Figure 3.4: Dried fish value chain in the study location

The dried fish value chains in both locations suggest that fishers are the mere suppliers of the raw fish that proceeds for processing. The real market interactions start at the processing nodes. In figure 3.4, the deep arrows show that the dominant exchange process and the dotted arrow shows opportunistic exchanges. The value chain and market system are determined by economic logic of price relationship and incremental benefits along the value chain. There is evidence of adjusted vertical integration where only one actor dominates the chain. In case of feed mills, which constitutes about 30% of the dried fish market is dominated by feed millers and their agents. In case of dried fish for human conservation, market consolidation is happening at four levels. The interactions are quite intense at all levels. The direct connection between wholesale markets with resource systems and processors is quite sketchy. They mostly operate with an inductive logic of commodity value chain that is determined by competitive advantage offered by different market agents and market channels in terms of price and product quality.

3.5.4. Dried fish value chain analysis with SES Perspective

Died fish operations in the study sites are mostly managed by small-scale operators in the marine fishing sector (Table 3.1). There is little contribution by the inland sector, mostly limited to river mouths and estuarine regions. Feedbacks, linkages, uncertainties, and emergences as critical attributes of SESDFVC are understood with empirical evidence from the case study sites.

3.5.4.a. Feedbacks in dried fish value chain operations

The dried fish value chain in the study region witnesses non-linear feedback from within and outside the fishing sectors. Feedback loops are shaped by multiple factors. As a system feedback, intensification is observed in production, technology and gear, competition for fishing areas, and changing habitat characteristics at the bio-physical resource node. Processing and marketing node also experienced multiple feedbacks with expanded bill of materials (BOM) structure, greater mobility of fish catch, and blurred geographic division in terms of procurement of desired dried fish species. Similarly, diversification and change in societal interactions are manifested with increasing labour mobility within and outside the fishing sector and a deeper understanding of place-based factors such as the lunar cycle.

The dried fish operation is determined by the production of select marine species used for drying. The marine production trend over the last decade in the study area provides a discouraging trend. The decadal data suggest that there is an impressive growth with a cumulative annual growth rate (CAGR) of 8.69% in Odisha and 2.03% in West Bengal. However, the share of marine production in Odisha has dropped from 34.56% in 2010–11 to 19.32% in 2019–20. Similarly, the marine production share in West Bengal has declined from 15.82% to 10.07%. The standard deviation in marine production in Odisha (S = 0.17) and West Bengal (S = 0.12) for the same period suggests a fairly constant production trend (Table 3.2).

Table 3. 2: Production Dynamics of Marine and Inland Fisheries in the Study Region

Production of marine and inland fisheries in Odisha and West Bengal (2010-11 to 2020-21 in 1000 tons)					
	N	Minimum	Maximum	Mean	Std. Deviation
Marine Pdn_Od	10	1.14	1.59	1.3840	0.17102
Inland pdn_Od	10	2.53	6.60	4.0690	1.47069
Total Pdn_Od	10	3.82	8.18	5.4540	1.62372

Marine pdn_WB	10	1.52	1.97	1.7830	0.12667
Inland pdn_WB	10	12.46	17.70	14.6680	1.59976
Total pdn_WB	10	14.43	19.52	16.4510	1.58507

(*Od- Odisha; WB- West Bengal*)

The discouraging marine catch has triggered intensification of catch with increasing numbers and rate of upgradation of vessels. As a result, the catch per unit effort (CPUE) has been declining. There is a steep rise in fishing vessels with a 163% rise in Odisha and a 41% increase in West Bengal over the last decade (GOI, 2013; GOI 2021). In particular, the share of the non-mechanized motorized sector is about 41%, and traditional crafts are about 44% in the region, including Odisha and West Bengal. However, the CPUE is on a steady decline. These sectors are critical for DFVC as the primary data from both the field sites suggests that dried fish production is heavily dependent on them.

Further, the craft wise production data from Odisha (Figure 3.5) suggests that the CPUE in the non-mechanized sector is in a steady decline as the fish landing is more or less constant with a standard deviation of 0.03 (S = 0.03). The mechanized sector has shown maximum growth with 6.58% of the total vessel (GOO, 2021), 47.6% of the total catch, and a last 10 years' CAGR of 6.47%. The non-mechanized, motorized sector has a share of 45.51% of vessels and 35.38% of catch, with a CAGR of 4.28% over the last decade. In contrast, the traditional sector is facing a serious challenge with 47.89% of vessels sharing 17% of the catch and a CAGR of 3.13% for the same period of time. 80% (n = 40) of the respondents from the fishers' segment and 64% of the processors (n = 20) segment also corroborate the fact that there is a strong decline in the availability of fish for processing and drying in the study location.

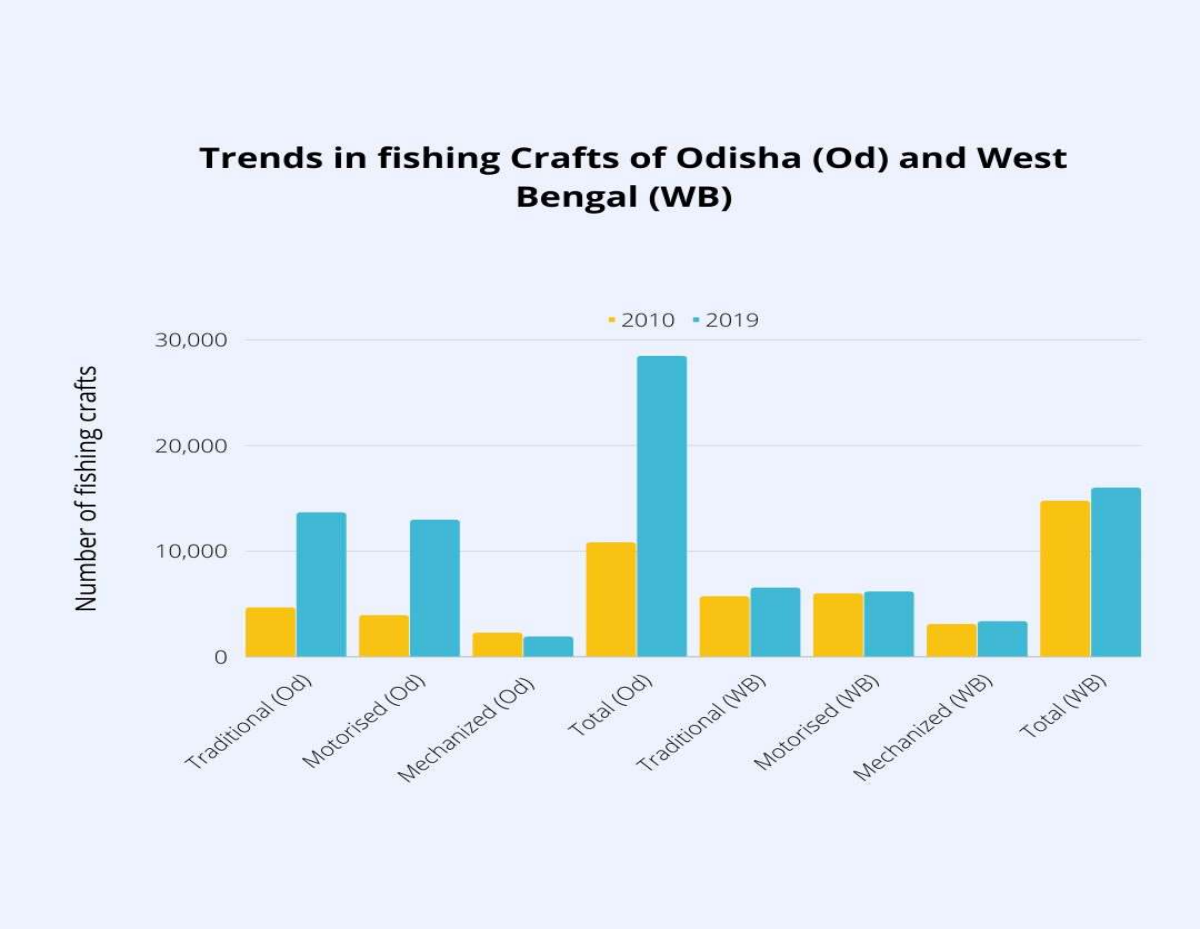

Figure 3.5: Comparative picture of fishing crafts (source: GoI, 2014, 2021)

The gears used in all the three sectors have also experienced a major shift with an emphasis on catching small fishes (Devadasan & Boopendranath, 2009). In the study sites, 75% of the households have upgraded their fishing gear and boats to higher capacities with the intention of covering more fishing space and targeting greater volume of catch. Large trawling nets used by mechanized boats are exploiting the juvenile fish stocks and larvae. Bottom trawling is causing serious destruction to fish habitats (Ghosh et al., 2022). By-catch has grown significantly due to prolonged fishing trips with improved capacity vessels (up to 40 tons), emerging markets for bycatch as fish feed and poultry feed, and the fertilizer industry. In addition, there is a significant illegal catch by trawlers in artisanal areas due to weak law enforcement. The estimated volume of illegal catch in artisanal fishing areas on the Odisha coast alone is between 2,100 and 4,100 tons (Pramod, 2010; Pramod & Pitcher, 2019). Illegal fishing refers to, inter alia, “activities by a foreign vessel in the waters of a coastal state without its permission, and fishing activities by vessels flying the flag of a non-member in waters regulated by an RFMO” (FAO, 2001, p. 2).

The overemphasis on shrimp and aquaculture in this region is also adding problems of releasing toxic water, catching juveniles, and generating a considerable volume of by catch. In Odisha, fresh water aquaculture has grown 2.3 times since 2010-11 with a CAGR of 9.67%. Brackish water aquaculture has shown 7.5-times growth with a CAGR of 25.14% during the same period.

The species wise landing data from the study site indicates a marginal increase in production of preferred dried fish species (Figure 3.6). The primary axis suggests the decadal mean production in '000 tones and the secondary axis represents the CAGR in percentage terms which is negligible for most of the species. At the same time, CPUE is negative owing to the increased number of vessels and improved gears.

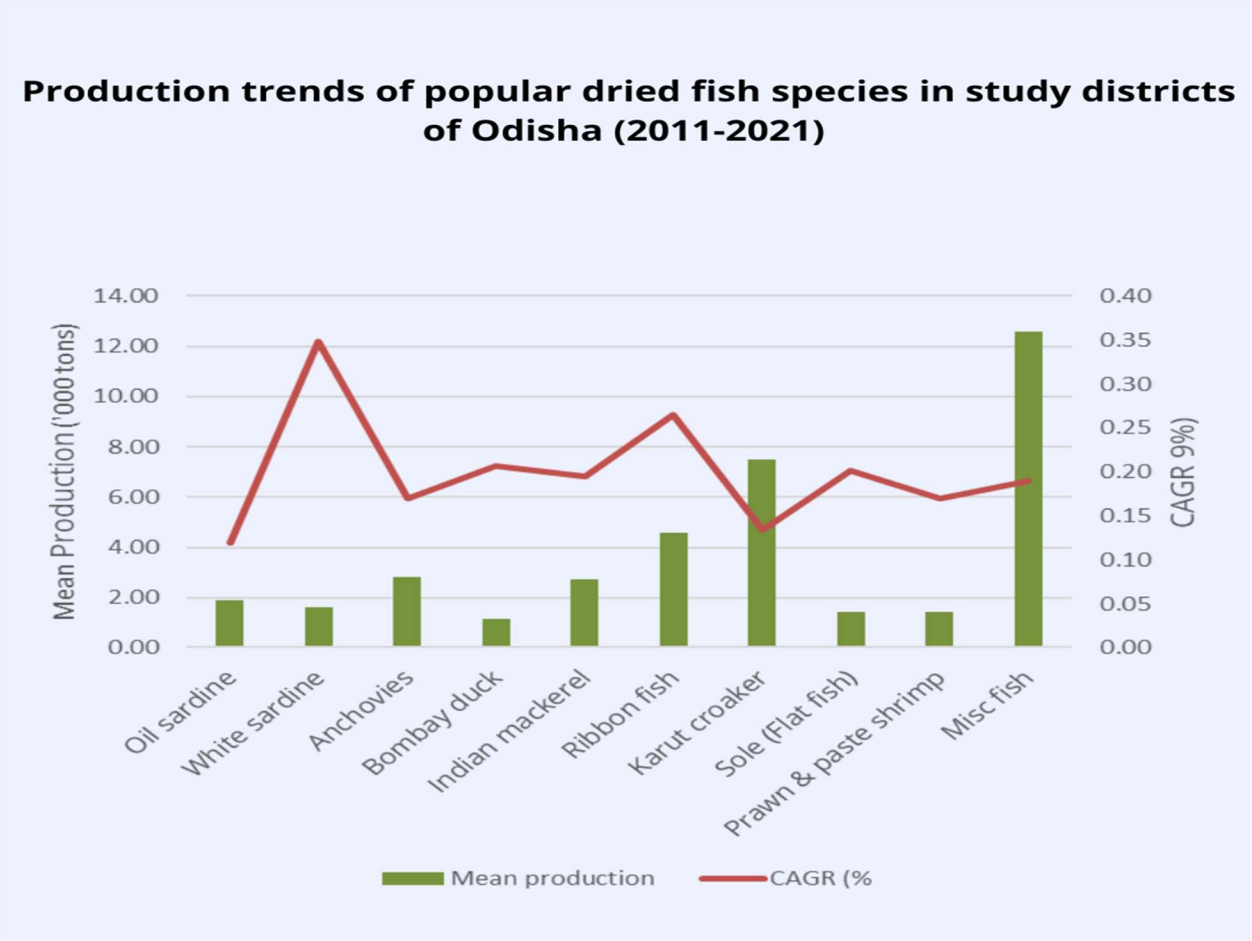

Figure 3.6: Decadal mean production (primary axis) and CAGR (secondary axis) of select species preferred for drying (source: GoO, 2022).

The respondents were asked about their top five preferences for dried fish based on production and marketing, as can be seen from data presented in table 3.3. As revealed in table 3.3, fifteen species have received the maximum number of responses. Species such as Indian mackerel, oil

sardine, ribbon fish, prawn, Indian anchovy, and croakers are found to be the most preferred species for drying. Mini Chandi (*White sardine*) is primarily processed for the fish mill and poultry feed industry.

Table 3.3: Dried fish species preference matrix

Dried Fish Preference Frequency									
Sl. No	Type	Common name		P-1	P-2	P-3	P-4	P-5	Mean Preference Frequency
1	Moti/Marua	Indian mackerel	*Rastrelliger kanagurta*	19	9	19	4	8	11.8
2	Kokali	Oil sardine	*Sardinella longiceps*	16	18	3	3	12	10.4
3	Sankha	Golden anchocy	*Coilia dussumieri*	1	24	5	12	2	8.8
4	Borei	Karut croaker	Johnious carutta	1	8	17	8	6	8
5	Jagar	Small Bengal siver body	Gerres setifer	4	5	5	14	12	8
6	Ruli	Ribbon fish	Lepturacanthus savala	23	2	0	7	2	6.8
7	Chingdi	Paste shrimp	Acetes indicus/P monodon	15	3	1	6	8	6.6
8	Chauli	Indian Anchovy	Atherinomorus lacunosus		5	8	8	3	6
9	Lahada	Bombay duck	Harpadon nehereus	3	2	8	4	12	5.8
10	Chandi	White sardine	Escualosa	2	8	7	5	6	5.6

			thoracata						
11	Manohari	Commerson's anchovy	Stolephorus commersonnii	0	5	12	5	6	5.6
12	Phaasi	Moustached thryssa	Thryssa mystax	9	2	6	5	2	4.8
13	Tauri	Barred spiny eel	Macrognathus pancalus	0	0	0	12	10	4.4
14	Polagara	Indian glass fish	Gudusia chapra	0	8	6	3	2	3.8
15	Hilisa	Hilsa	Tenualosa Ilisha	4	1	4	2	5	3.2

The decline in CPUE has not only enhanced the vulnerabilities of fishers and small processors, but it has also reduced their negotiating power in the value chain. One elderly man, during a semi structured interview, said that "*Dariare machha thile sina ame raja." Machha Kamile Beparinka Raj"*. This means when there is fish in the sea and the catch is good, the small-scale processors have better negotiation power. When there is less fish, they need to depend on commission agents and trawler crews for inputs and prices of the dried fish. This clearly suggests that resource conditions in terms of small fish availability play a greater role not only in demand and supply equations, but also determining the power in the market.

The processors are diversifying their portfolio by expanding their BOM especially with the emerging feed industry. About 50% of the total production at the processing unit level is used in fish and animal feed. In the face of growing uncertainty about catch, families having more than one adult male member are opting for employment in fishing fleets and wage-migration to cities. They are also taking up higher value chain roles such as community level aggregators and commission agents. From the survey, it is also found that some people prefer to migrate to nearby cities for wage employment on a daily basis and go fishing during the peak fishing period of the month. More fish is available during the *uthia* times according to lunar cycles (12-day period during the lunar cycle corresponding to the waxing and waning of the moon).

On the market front, with greater investment and mobility, the traditional boundary of geographical separation of landings and procurement patterns is changing. There is greater exchange of products between the south and north Odisha coasts and the West Bengal coast due technology and communication advancement. Traders from Digha-Mohana market have agents in Paradeep and the traders from Sunakhala are also procuring select dried fish species like *Karut croaker* and *Indian anchovy* from the Paradeep region. Paradeep traders are procuring *Indo Pacific tarpon* and *Flat head mullet* from the south coast. Further, with the expanded BoM structure, the dried fish traders are tapping new market opportunities. They specialize in various activities like animal feed, frozen fish, and processing other than drying.

The commodity orientation of traders and large-scale processors fuels extractive fishing practices mostly in motorized and mechanised sectors. It has negative implications for artisanal fishers and small-scale dried fish processors. Fishers recalled past incidences of collective struggle against large operators violating fishing norms and transgressing into artisanal fishing areas. The protests resulted in an organized move by trawler owners to stop supplying "C" class fish to small scale processors. They are increasingly opting for trade in the sea among the trawlers of neighbouring states. Due to high overhead costs, the low scale of processing operations limits the capability of small-scale processors to tap the distant markets. Hence, the dependency on local aggregators is high even with low bargaining power. One respondent said, "Kankadaku *golia pani suhae"*. It means "crab loves muddy water", and here it is implied that the market agents are taking advantage of the situation.

Ninety seven percent respondents (n=110) have also raised their concerns about the feedbacks form external drivers including industrialization and the prolonged fishing ban. The region, particularly, people of Kajalapatia are facing conservation ban for Olive Ridley protection for 7months followed by monsoon ban of 45 days. There is a critical influence of other terrestrial, freshwater, and near-shore interventions on the bio-physical characteristics of the marine resource system and thereby causing threats to fisher's livelihoods (SIWI, 2019). While fishers succeeded in receiving $106.66 (INR 8000/-) as compensation for loss of employment during the fishing ban, it is insufficient to run the family. Moreover, the compensation is linked to active fishers. Many women engaged in fish processing do not qualify as active fishers and therefore, rendered to extreme vulnerability because of industrial pollution and fishing ban within 20 kilometers from the coast.

The opportunity for livelihood diversification on the part of fishers and small-scale processors is low due to lower educational achievements. Sixty percent of males and 13% of females are educated up to primary school (grade V). Twenty six percent of males and 20% of females have attained secondary school, and 0.06% have gone beyond secondary education. However, the general trend is that most members of the younger generation prefer to opt for jobs in mechanized boats and outside rather than do fishing on their own due to increasing vulnerabilities in the artisanal sector. We found two distinct patterns in this. One group of people are migrating for a certain period of the month and returning to the village during the *Uthia* period. The other group of people are leaving fishing operations altogether. This leaves women and older members of the household to undertake the processing activities, and they mostly depend on local aggregators and market agents for the sale of their produce.

As disused above, from the fishers and small-scale dried fish operators' perspective, change fishing technology and gear, blue economic forces including thrust on aquaculture, industrialization, expanded BoM through market expansions along with conservation priorities of state is causing negative feedback loops in the system. At the same time , there are evidence of balancing feedback loops with people opting for diversified livelihoods options, provision of state welfare schemes and opening of new markets (poultry feed and animal feed), even though they are grossly inadequate to arrest growing vulnerabilities among upper segment actors.

3.5.4.b. Linkages in the dried fish value chain

The linkages in DFVC in the study region are dynamic and actors role and behaviour across value chain nodes are influenced by biological flows, customary norms, social interactions, formal national and international provisions. It is evident from the field observations that the fish catch is dynamic and not well distributed across months and years. Fishers catch more fish during the uthia period and hence availability of fish processing is quite high. The other natural factors such as seasonality, weather conditions influence the fish catch as well. Fishers get higher catch in rainy season, winter season and before the cyclonic storms. However, in site 1, the fishers are deprived of taking seasonal advantage due to prolonged fishing ban.

Such dynamic flow of fish makes value chain linkages dynamic as well. People engaged in processing use part of the lean patch of the month for processing and marketing of dried fish. Hence, most of the small-scale fishers also engaged in processing as it offers employment for longer period of time in a month. During the lean season, dried fish processors depend on

commission agents and landing site auctions for buying C' class fish (low value small fish and or the fish that are in perishable condition and self-life cannot be increased even with ice application) from trawlers operating in the EEZ (Exclusive Economic Zone) and process them as dried fish. According to the guidelines for fishing operation in EEZ, 2014, deep sea fishing is allowed in areas up to 200 nautical miles beyond shoreline and territorial water i.e., 12 kms from the shoreline. In site 2, the dried fish operation is little different as compared to site 1. Here mixed responses are found. Processors close to Digha and Mohana depend on the Digha market committee auction for procuring fish for drying, and the artisanal fishers who are also engaged in processing are using their own catch and buying fish from their fellow boat owners. Below, we analyse rules, resources, relationships, and actor roles to understand the dynamic linkages that determine the structure and conduct of the DFVC.

Rules and resources

Rules and provisions regarding resources access and trade often influence power dynamics, vertical and horizontal interactions among value chain actors (Ommer et al., 2012). Empirical data from the field reveal a complex mosaic of interactions and linkages as the dried fish operation is influenced by both formal and customary rules (Table 3.4). The federal and state level policies have differential implications of people operating in the dried fish value chain.

Table 3.4: An overview of formal and informal rules that influence different nodes of SESDFVC.

Rules	**Fisheries (relevant dried fish operation**	**Processing (Dried Fish)**	**Trading and wholesaling (dried fish)**
Formal rules	Priority on aquaculture, export promotion, high value fish, creation of infrastructure for mechanized fishing, live and frozen fish marketing, Incentives for the upgrading of traditional crafts Cage culture fishing in the sea supported with necessary legal provisions. Restriction on mechanised fishing in artisanal fishing areas.	Higher incentives for frozen and processed fish like fish fillets, fish fingers etc. Capacity building of women's SHGs for hygienic fish drying and post harvesting practices. The expansion of	GST waiver. A little thrust on the eco-levelling of dried fish. The ASEAN agreement helps to diversify trade. Under the automatic route, 100 percent FDI is allowed in the pisciculture and aquaculture sectors in India. Under the automatic route, the non-resident investor or

	Fishing restrictions in Bhitarkanika marine protected area (site 1) Fishing ban from 1st November to 31st May for Olive ridley conservation (Site 1 & 2). Monsoon fishing ban (April 15 to June 15) One time compensation of $100 (INR7500/-) for marine card holders to cope with the fishing ban (site 1 & 2). Savings and relief scheme with 50% beneficiary contributions (site 1 & 2).	poultry and aquaculture results in a demand for feed. Import subsidies on low value species under the ASEAN trade agreement are not favourable to small-scale processors. FIDF credit linked support.	the Indian company does not require any approval from the government of India for the investment.
Informal rules	Demarcation of fishing area on mutual consent. Sharing of labour for fishing In the case of trawler drying, 90% of the receipt from dried fish is shared with crew members. Annual contract with crew member with advance. The cleaning of boat after every fishing trip.	Annual booking of boat owners for fishing with advance payment. Shared labour for drying operation Rs.500/-commission per quintal sale of dried fish.	Booking of boats on an annual basis with advance payment for assured supply. Credit to small, dried fish fishers and processors Loyal commission agents operating in the village

A growing emphasis on the blue economy has created a complex policy environment with multiple priorities. The fisheries policy framework (draft National fisheries policy, 2020, Pradhan Mantri Matsya Sampada Yojana, Odisha fisheries Policy, 2015, West Bengal fisheries Investment Policy, 2015) in the study region places greater emphasis on exports, candidate species like shrimp, aquaculture, mechanized fishing, and new market access for live, frozen, and processed items. Such an environment has differential implications for the structure and conduct of value chain actors operating in different nodes of the DFVC. Small scale fisheries are also regulated through customary rules and collective choice arrangements that are co-evolutionary in nature. Communities have collective rules for the sharing of labour, unwritten agreements, and

partnerships ratified by village institutions and caste federations. For example, determining fishing areas in the river and sea through mutual consent. At meso level, they have fishers' federations and boat associations to protect their members' mutual interests. Though there is no exclusive dried fish processors' federation, in both the study sites, due to their mixed identity, they are members of the fisher federation and boat owners' association. The traders are also members of the regulatory marketing cooperative society. However, these institutions are experiencing transitions under the influence of macro policy drivers.

The capital-intensive fisheries with greater programmatic impetus are sabotaging the interests of the poor. Poor fishers are still suffering from depleting CPUE despite the mechanized fishing restriction in artisanal areas. At site 2, the labour-relation are also changing as fishers are seeking employment in aquaculture farms. The composition of the fishing community is changing, with non-fishers and private investors assuming a greater role in trade and even fishing activities. It is no longer a caste-based operation, and hence the customary norms are losing ground. The change in power is causing value chain decisions to be fisheries-centric, with a focus on marketable species and products rather than fisher-centric, which are mostly driven by skill, competence, and local ecological knowledge systems. At the same time, interactions with traders suggest a greater collaboration of large players of different states, and the landing dynamics have changed due to the exchange of fish in the sea among trawlers.

Processors from study site 1 are experiencing fewer landings of c-class fish as they protested against mechanized fishers for intruding into areas beyond the EEZ and pricing of trash fish. Site 2 offers a different trade equation. Due to repeated natural disasters that occur frequently, the basic infrastructure for drying is severely damaged or destroyed. Hence, the community switches in and switches out of the dried fish processing activities. The people who run small drying units often switch to the live fish trade till they rebuild their infrastructure. For example, the dried fish processors at site 2 have temporarily suspended drying activities after repeated cyclones of Fani in 2019 and Yash in 2020. They are now selling live fish to market agents from Balasore and Digha.

There is provision for contributions and relief schemes to tide over the ban period. The poor fishers are not participating in this scheme as they are unable to manage beneficiary contributions. The following depiction of a respondent from site 1 explains the reason for the low

uptake of the scheme: *"We live on our daily earnings. Whatever little amount is saved is paid to the money lender, from where can we get additional money to save? "*

Under a group insurance scheme, fishers are covered for accidental and death benefits while on duty in the sea. Women, small processors who do not go into the sea and small market agents who are frequently rushed to catch the timing of fish landing and auction are also excluded from the scheme. About 55% (N = 64) of the fishers and dried fish processors availed themselves of the informal credit sources. Only 7% of respondents in site 1 and 12% in site 2 have received credits from the bank. Twenty five percent of respondents do not have marine identity cards and residential proof, which are mandatory for institutional credit as they are migrants. In Site 2, fishers are small scale dried fish operators who are denied credit by banks due to irregular payment of loan instalments for earlier advances.

As per the sequence of preference, friends and peers, advances from traders and market agents, SHG groups, and money lenders are considered as major credit sources. In the event of availing credit from market agents, they have little room to negotiate on the price because they are forced to sell their produce only to the agents as a way to pay back the credit. The interest rate for loans from micro-finance institutions and local money lenders is about 24 to 36% per annum. Many SHG groups in the study region have received seed capital, solar infrastructure, and bank linkage support for establishing group enterprises for hygienic dried fish production. However, these institutions are facing serious challenges of high transaction costs, low inventory data support, lack of transparency in business transactions, and low market support. Such processes often lead to market and institutional failure.

The fish processing units in India are functioning at 32% of their capacity in India (Salim, 2012) and they are consuming most of the fish catch. International trade agreements such as the SAARC preferential trading agreement (SAPTA) and the ASEAN framework of trade agreements changing the trade linkages among member countries with facilitative legal and financial incentive provisions. SAPTA aims to promote and sustain mutual trade and the economic co-operation among the SAARC member countries through exchange of trade concessions. The Association of South-East Asian Nations (ASEAN) comprises of Indonesia, Singapore, Philippines, Malaysia, Brunei, Thailand, Cambodia, Lao PDR, Myanmar and Vietnam. India has a strategic trade partnership with ASEAN since 2012. The ASEAN framework provides for import duty exemption on species including mackerel, sardines,

anchovies and crabs from member countries like Thailand and Vietnam. Such trade raises apprehension of further marginalization of small-scale fishers and processors with low bargaining power and heavy price competition. The study region is gradually gearing up for these changes in market economy as it is conveniently positioned for trade interactions with southeast Asian countries. As a welfare measure, the government of India has exempted goods and services Tax (GST) on dried fish as it is practiced by poor fishers. While this is a welcome step, it is leading to manipulation with non-transparent business process and manipulated data by traders.

Roles and relationships

There are fuzzy boundaries across value chain nodes due to strong overlaps in the functioning of different economic agents. The broad suit of simple indicators and rules in practice by the community evolves through time and has built in adaptability and flexibility in dried fish operations across value chain nodes. The value chain follows a scientific model with a relative emphasis on higher scale issues. However, it is necessary to have local level understanding as it complements science precisely where information is poor. Analysis of local practices offers a stronger understanding of system feedback as such practices and engagement pathways evolve with gradual understanding of the environment and collective learning process (Berkes & Berkes, 2009).

Out of 110 respondents in the study village, 76 respondents (69%) have mixed identities as boat owners, fishers, and processors. We define mixed identity to explain the multiple, overlapping, and simultaneous roles that actors play within a value chain according to their capacity, in some contexts, and their precarious social-economic situation, elsewhere. The following table (Table 3.5) summarises the roles of respondents obtained from the village survey covering 110 households.

Table 3.5: Distribution of respondents according to their role in the upper segment of the value chain

Roles	Site-1	Site-2	Grand Total
Only Boat Owner	2	7	9
Only Fishers	1	15	16
Only Fish workers	0	9	9

Boat Owners+Fishers	0	2	2
Fishers+Boat Owners+ Dried Fish Processors	53	0	53
Fishers+Boat Owners+Dried Fish Processors+Traders	2	0	2
Fishers+ Dried fish Processors	1	12	13
Fishers+Workers	0	6	6
Grand Total	59	51	110

In 93% of households, while male members work as fishers, female members are primarily engaged in small-scale processing activities and also work as wage laborers in relatively bigger processing units in the village. Six percent of fishing and processing households, which have additional human resources but a limited capital base, are simultaneously operating as local aggregators and traders. In the case of upper segment actors, the relationships are complex and not always driven by financial return. In one of the interactions, a fisherman from NM Padia village narrated their association with the value chain in an interesting fashion. He said, "*From our childhood, we have been fishing in the sea. We have learnt this from our forefather. What else can we do? Even if it is difficult to meet the daily needs today, how can we leave our occupation?"* This statement speaks about the cultural and emotional attachment to the occupation, which drives them to continue with the activity in spite of innumerable challenges. Therefore, they are exploring various options within the sector to earn their living.

Beyond the processing node, the transaction takes a dynamic path with multiple exchange patterns. The transactions are determined by the volume of produce, the processor's financial strength, and access to market actors. In the case of self-employed processing enterprises, the chain is typically longer than that of a mid-size processor with volume of production. With the growth in fish mill and poultry feed markets have opened, organized trade interactions are observed in the study location. Companies appoint collection agents to procure materials from processors, and hence, all processors, regardless of size, have access to such market actors. As a result, price asymmetries in the feed industry are not severe. However, due to the length of the supply chain, price disparities are greater in the case of dried fish for human consumption. As seen in Site 2, there is better access to export and a larger terminal market, such as the Balighai dried fish market. Approximately 25 to 30% of the produce is exported to neighboring countries. However, processors in Site 1 do not have direct access to terminal markets or exporters. They

rely on market agents and intermediary markets to sell their goods. Hence, the share of consumer rupee at the processing and fisher level is lower in site 1 than in site 2.

Trade links are becoming more complex as communication and transportation facilities improve. Traders are now operating on a larger scale, targeting different markets for specific species and better price realization. They used to have commission agents at the community level, but with higher fluctuation in supply, they are diversifying their procurement base. Such horizontal material exchange has resulted in the emergence of a new set of market actors. Because of the expanded BOM structure of preferred species for dried fish production, there is a greater alignment and consolidation of actors. In Sunakhala, for example, 45% (9 out of 20) dried fish wholesalers have shifted their trade focus to other activities such as frozen fish, fish mill, and animal feed. This suggests that the inter and intra node linkages are becoming dynamic with varied implications to different actors in the chain.

3.5.4.c. Uncertainties

Uncertainty is a critical attribute in the social-ecological system (Biggs et al., 2015). It is characterized by random fluctuations, surprises by nature and structural uncertainties (Charles, 1998). It includes multiple micro and macro factors that influence demand and supply variability in terms of product, process, price, people, and place relationships in the value chain. The study area is frequented by natural disasters. Such surprises by natural forces have a strong influence on DFVC. The structural uncertainties in the study area are also influenced by policy and programmatic dimensions related to the prolonged fishing ban and blue economy drivers.

Responses from value chain players across nodes, including fishers and dried fish processors (Figure 3.7), indicate a decrease in catch, prolonged fishing trips resulting in high input costs, a decrease in CPUE, and greater fish/fish product mobility. Furthermore, macro drivers such as zero import duty on low value fish, expanded BOM structures, and blurred geographic division are acting as triggers for strong market fluctuations and less control over resource flows to optimize the enterprise's use of fixed and variable costs. The perishability of fish, combined with the low financial capacity of the fishers and dried fish processors, adds to the complexities of management decisions. The impacts of climate change are also felt on fisheries. Changing climate vectors are resulting in impacts at two levels; first on fish stocks, and second, on the critical marine and coastal ecosystems on which they depend (World Bank, 2017).

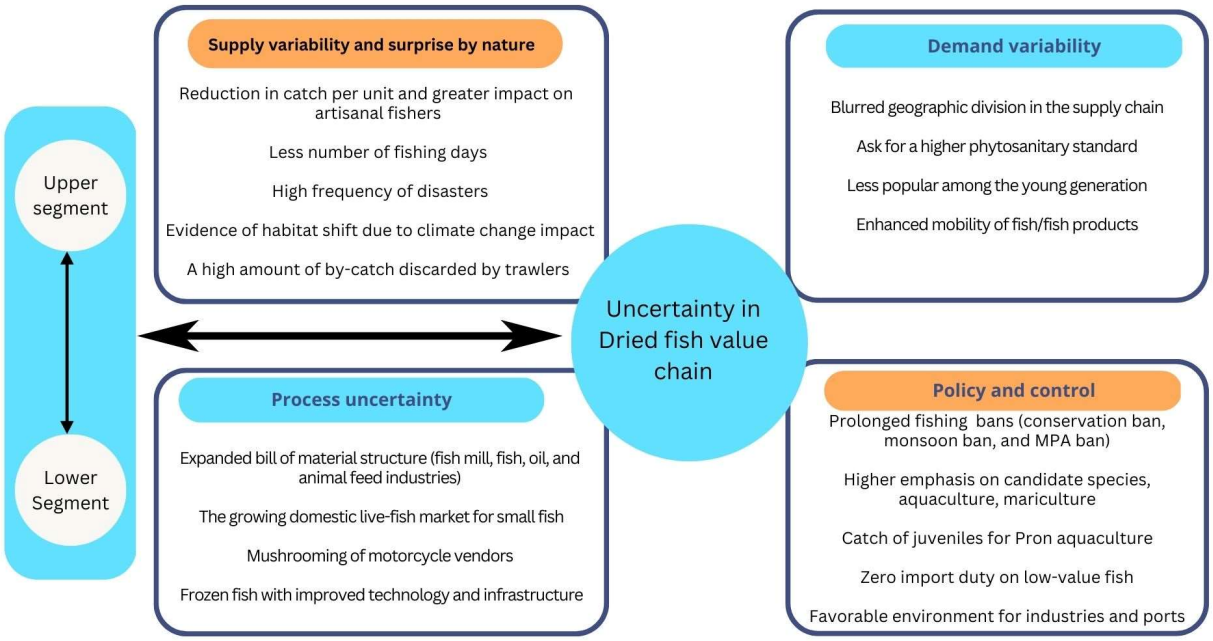

Figure 3.7: Matrix of key characteristics of uncertainties in the study location

The feedback from environmental factors is causing market system distortion in the study location. The region is experiencing increasingly severe weather events. Because of its flat terrain and deltaic plain formations, India's east coast is considered more vulnerable (Zacharia, et al., 2016). According to the Indian National Centre for Ocean Information Services (INCOIS) study, the study region, which includes Jagatsinghpur, Kendrapada Balasore, and neighbouring areas, has a high to medium coastal vulnerability index (CVI value 4.5 to 9.5 is considered as medium and above 9.5 is high). According to the Intergovernmental Panel on Climate Change (IPCC), the frequency and intensity of tropical cyclones in this area are expected to increase (GoO, 2015; Kumar et al., 2010; Langsdorf et al., 2022; Pachauri et al., 2015). Over the last 100 years, the region has experienced 262 cyclonic disturbances, including 69% of depressions, 22% of storms, and 9% of severe cyclonic storms (Barik, 2019; OSDMA, 2019). According to a spatiotemporal study conducted by Bandopadhyay et al. (2021), 80% of the storms that occur in the North Indian Ocean landfall in the Bay of Bengal, of which 40% hit Odisha and the West Bengal Coast (Fig.3.8). The graph below depicts the occurrence of cyclonic storms in the study region over seven time periods. The sixth assessment report of the IPCC indicates greater uncertainty with a higher frequency of severe cyclones (Bandyopadhyay et al., 2021; Langsdorf et al., 2022).

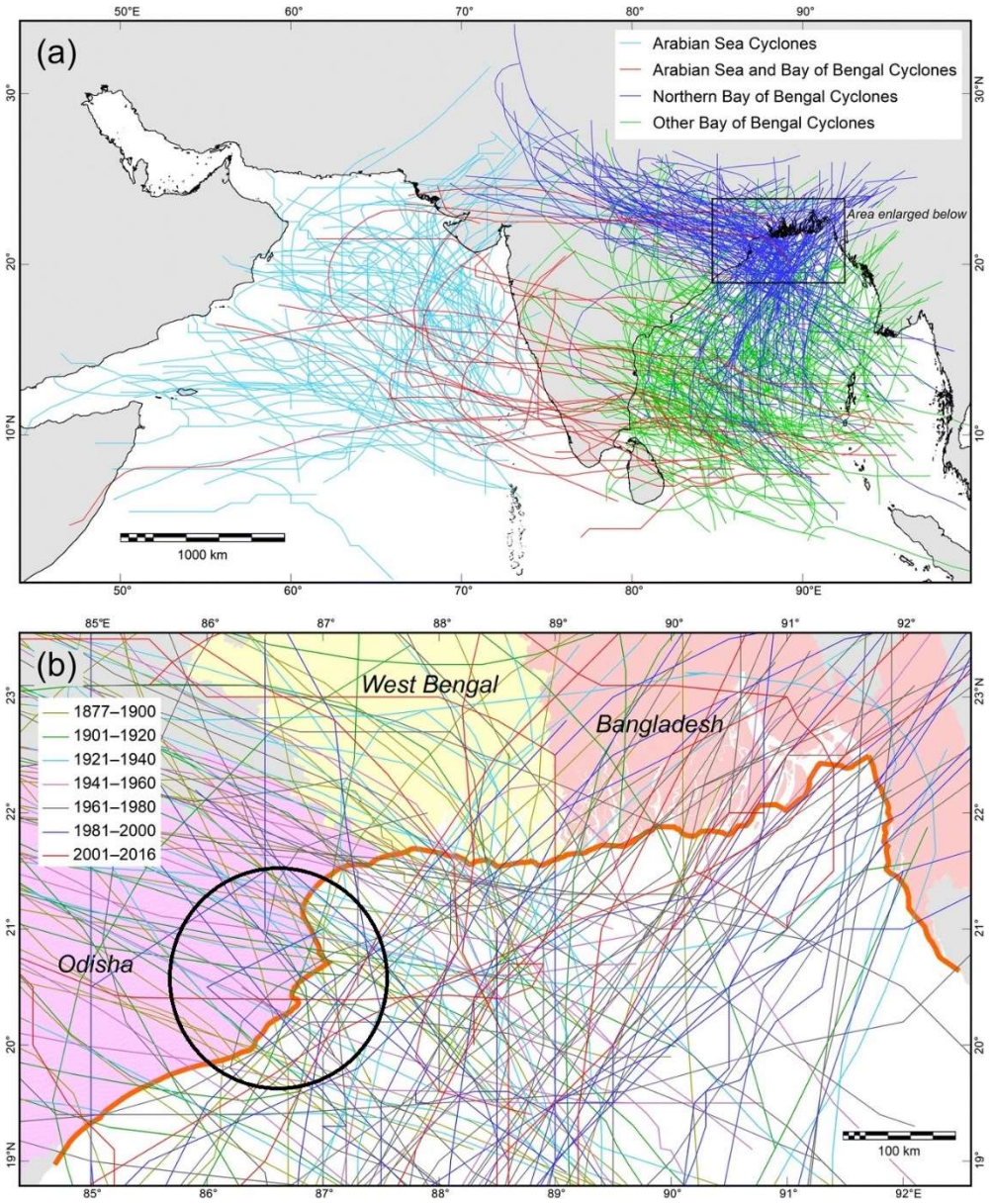

Figure 3.8: Storm and landfall analysis in the northern Bay of Bengal from 1877 to 2016 based on storm track data from IBTrACS and IMD (Adapted from Spatiotemporal Analysis of Tropical Cyclone Landfalls in Northern Bay of Bengal, India and Bangladesh by Bandyopadhyay et al., 2021 p.802 [62]).Black circle indicate the case study location.

There are also evidence of habitat shifts of different species due to variability in climatic as well as oceanographic parameters. Changes in marine species migration patterns have been observed in two important dried fish species, including Indian Mackerel and Oil Sardine, over the last 50 years (Zacharia, et al., 2016). One 54-year-old person from Kajalapatia village narrated one incident that justifies such scientific analysis. He said at his young age," during blue moon time,

once he caught 70 bags of Indian sardines in one day. Now it is a dream. Even after two days of fishing, they are returning with 50-100 kg of fish during the blue moon period."

According to the community members, they have never experienced such a situation of three cyclones in successive years. Cyclones Fanni, Amphan, and Yash hit the coast back-to-back within three years' time. The frequency of weather warnings for refraining from fishing due to weather disturbances has also increased. While the information system is helping them to save lives and assets to a great extent, such weather disturbances cause a reduction in fishing days. In the case of dried fish operations, the small-scale operators are taking much longer periods, say for several months together, to resume their work as most of their assets, like racks, containers, and sheds, are often lost to such events. The fishers who are doubling up their roles with drying have revealed that in such events they first look for resources to resume their fishing operations so that they can have some earnings instead of focusing on drying activities. At site 2, with back-to-back cyclones, they had to temporarily suspend drying activities as their basic infrastructure was destroyed. However, they are now selling fish to live-fish traders in Digha, Chandanpur, and Balasore. The environmental vulnerability, production and trade uncertainties are multiplied due to the prolonged ban for 7 months, including the conservation and monsoon ban period. The supply is erratic as the conservation ban prohibits fishing by artisanal boats within a 5 km radius, by motorized boats within 10 kms, and by trawlers within a 20 km radius.

As far as the demand side uncertainties are concerned, respondents' orders of importance varied considerably. The growth of the domestic live-fish market for small fish, the mushrooming of motorcycle vendors, and the low preference by the younger generation for dried fish were cited as main reasons that had also been impacting the dried fish sector. However, people also said that there is an emerging new market for selective species like anchovy, dried prawn, and Khainga through online trade if it is processed with the desired phyto-sanitary measures and with less odour. Such demand uncertainties call for value chain support in terms of common infrastructure facilities, quality control assistance to small scale processors, and creating an enabling environment for dried fish processors to access the new markets.

Uncertainties have also multiplied under the influence of various government policies. The prolonged fishing ban has a disproportionate impact on the fishers operating in non-mechanized boats who contribute most to the dried fish. Besides this, the higher emphasis on aquaculture, industrialization, and ports causes pollution and adverse impacts on the near shore catch. Two of

the respondents for Kajalapatia village shared similar voice. According to them, *"Due to pollution, the fish movement has changed significantly; they are not found in or near the shore area." We are noticing that large quantities of fish are dying when they enter into polluted waters "*(Respondents 2 and 4 from site 1). Additional challenges are stemming from the the recent import duty relaxation for small fish imports by some Asian countries; this changing pricing and product mobility dynamics..

3.5.4.d. Emergence

SESDFVC with non-linear system feedbacks, dynamic linkages, and inherent uncertainties provides for multiple equilibrium with change in spatial features, technology, skill and place-based values of value chain actors. It embraces new adaptations through its emergent properties (Pradhan et al., 2022). The dried fish operations in the study region exhibit emergent properties across the value chain nodes. The dynamic resource and policy context triggered multiple changes and adjustments in the value chain operations. Changes and new adaptations have been observed in both the lower and upper segments of the DFVC. When asked about changes in dried fish operations varied responses have been obtained. Table 3.6 provides the response matrix of processors on the first reasons cited for changing dried fish operation.

Table 3.6: Response matrix on reasons for change in dried fish practice mentioned by the respondents (n=20)

Reason for change in processing sector	1st reason cited (% of response)
Low catch per unit	25
Restriction on fishing in estuarine area and artisanal fishing area	20
Bottom trawling Sona boat and trawlers	17
High by-catch discard by mechanized boats	13
Pollution	17
Fish mill and animal feed	8

The volatility and unorganized nature of the dried fish market exert a higher financial burden on self-employed dried fish processing units who mostly depend on their own catch for drying.

The spatial features of the study area (Table 3.7) imply a greater appetite for the motorization of traditional crafts by lower end value chain actors. The policy preference for aquaculture candidate species together with the emerging market in the sea and subgroup collaborations among value chain actors are leading to novel fishing practices and labour dynamics. Novel fishing practices also trigger intra community conflicts (e.g., mechanized boat owners vs. artisanal fishers). Self-employed enterprises are also adjusting their roles as live fish sellers or dried fish processors and sellers, based on the type of fish catch and weather conditions.

By adopting such a situation specific strategy, they are both ensuring employment and coping with financial stress on a day-to-day basis. Mechanized boat owners are also keeping small boats to cope with the conservation ban for seven-months, as mechanized boats are not allowed within 20 kilometres of the coastline. The lower end value chain actors are adjusting their operations with greater focus on capacity optimization through various strategies. The traders (n = 8) reported that the species based geographic advantage has been blurred with the expansion of the sourcing base by the traders, which increased product movement from one state to the other. There is a growing importance of regionalization of trade by consolidating actions on specific value streams like frozen fish, live fish, fish products, and dried fish as per local consumer preference. The procurement agents from West Bengal are relying more on Paradeep and Huma markets. All the dried fish processors on sites 1 and 2 said that they sell their produce to West Bengal agents. According to a trader from Sunakhala market, "*getting a type of dried fish is not a big problem, but the real problem is cost, and assurance of availability based on demand." Now they have to maintain a greater stock with their own secondary processing facilities like second order sorting, grading and drying."* Such processes add to the cost and, according to him, the emerging feed market is really helpful as, in the case of spoilage of stock, they are not completely on the losing side.

Table 3.7: Spatial features of emergence in SESDFVC

Variables	Explanation of variables	Emergent Properties In SESDFVC	
		Upper segment	Lower segment
Spatial	Fishing and	Higher uptake of motorization of	Regionalization of trade

features	processing modalities. Collaborations and integration. Species preferences	crafts, associating more value to bycatch and trash fish. The export potential and trade signals altered the fishing practice towards candidate species like shrimp. Stronger subgroup collaboration prompting intra community conflicts Growing market in the sea (interstate trawlers are trading fish and by-catch in the sea) New labour dynamics with focus on aquaculture, mechanized fishing and expanded BOM along with multiple supply chains for dried fish.	Blurred geographic division in fish movement. Higher imports of Indian Mackerel and Oil sardine from neighbouring countries. Species focused trade arrangement and climate induced shift in fish habitat (e.g., Indian mackerel). Greater consolidation and specialisation because of enlarged domestic live fish market, frozen fish, other fish products, and fish and animal feed sector.

At practice and skill level, there have been multiple adaptations both at the upper and lower ends of DFVC (Table 3.8). The adoption and upgradation of technology in fishing, drying, improving safety and disaster risk reduction is changing the dynamics in the upper segment of the DFVC. Although most of the traditional craft owners and small-scale producers so far do not have access to such technological options. In the case of lower end value chain actors, the new emergences are seen in terms of tapping new markets with greater focus on odourless packaging, popularization of e-market platforms, greater use of communication technology for price discovery, and e-governance platforms to facilitate trade.

Table 3.8: Technology and skill dimensions of emergence in SESDFVC

Variables	Explanation of variables	Emergent Properties in SESDFVC	
		Upper segment	Lower segment

Technology and skill	Adoption of new tools, gears, business processes	Adoption of new technology like underwater camera to track fish movement. Gradual transition in crafts from manual to small engine fitted boat to high engine power, sona boat (13-meter-long boat with 5 ton fish hold capacity) etc. Gill net and bag nets are increasingly used in all sectors except manual boats due to shift in target catch. Families having more human resources are assuming the role of aggregator within the village. Small solar driers mostly promoted through Government projects (ICZMP, NRLM, PMMSY). Sporadic case of certification. Better preparedness through reliable weather forecasting and warning systems. Improved safety features with pucca housing and multi-purpose cyclone shelters	Better packaging techniques. Use of e-marketing platforms. Stronger communication platforms for price inventory. E-governance platforms to facilitate activities related to trade and export.

The dried fish value chain is diverse and has been strongly influenced by place-based values, such as collective action, caste dynamics, social ties, gender roles, indigenous knowledge and locally prevailing rules and practices, (Belton et al., 2022; Pradhan et al., 2022) . In the face of higher levels of marginalization, blurring caste and community-based identity, and the collapse of the geographical division of fish input and labour, the value chain actors are continuously realigning themselves to meet the challenges (see Table 3.9). At study site 1, fishers and dried fish processors are mostly migrant workers from West Bengal. According to our village survey, 57% of households have settled here between 1920 and 1970, and they are immigrants from the neighbouring places and elsewhere in the state of West Bengal. They migrated with a motivation related to higher fish availability. Further, immigration was accentuated after the 1971 Bangladesh war (Figure 3.9)

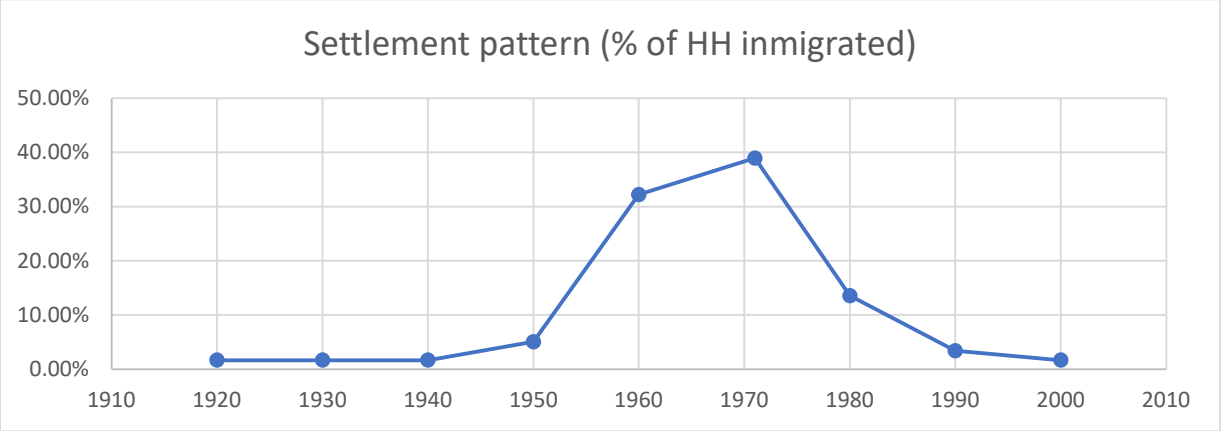

Figure 3.9: Settlement pattern in Kajalapatia village (study site 1)

Fishers are attempting to broaden their social networks as a coping mechanism despite low CPUE and increased financial stress. They are prioritizing community relationships over individual financial gain. Such social ties also help in sharing labour, capital, and assets with a higher trust level. Eighty four percent (n=40) of respondents stated that it strengthens their identity and political positioning as they share similar vulnerabilities. At the same time, women have started playing a greater role in dried fish value chain operations. The identity crisis has nullified the initial considerations of settling in green field areas having less competitions, rather they are inviting more people to gain political strength despite strong competition of space. The labour relations is also changing with changing gender roles.

Table 3. 9: Place based values and dimensions of emergence in SESDFVC

Variables	Emergent Properties in SESDFVC	
	Upper segment	Lower segment
Place based values	Strengthening community voice by facilitating immigration in site 1 as most of the fishers and dried fish processors are migrants from West Bengal and other coastal areas of Odisha. Women are assuming greater control with higher government patronage through Self Help groups, producer groups etc. The traditional knowledge of *Uthia, Padia* and fish habitats aid to recalibrate labour and finance for process optimization. During dry spell of the month and year they	Traditional supply chain is unreliable with high fluctuation of catch. The traders are no more solely dependent on community level agents of coastal villages. The interaction with markets like Balighai in West Bengal and Huma has

	are migrating to nearby towns in search of wage employment, With growing mechanization and motorization, co-ownership of vessels is seen as common practice as individual investment capacity is low. The prolonged ban for seven months in site 1 is forcing people to opt for jobs in mechanized fishing sectors and other unskilled job within and outside of the state. Many fishers and dried fish operators particularly in site 2 are seeking labour opportunities in growing aquaculture farms. The external and internal factors like conservation ban, MPAs, monsoon ban, high bi-catch discards by trawlers are recalibrating the occupation in terms of skill, technology and identity. However, 72% respondent considers fishing as their first choice and resilient force to deal with uncertainties at workplace. The new trend of women going inside the river and sea is found in site 1 to manage economic stress and labour scarcity.	changed There is stronger coordination with these markets for product mobility. The traders in Sunakhala were earlier dependent on Huma on buying of dried fish and trading in interior pockets of Odisha. Now there is circular movement of produce. If they are not getting better price in local market, they are reselling the stock in the Huma market itself

Due to rising costs and altered labour dynamics, women at site 1 have begun boarding the boat alongside their spouses. The other factor is that many women prefer spouses who are in stable employment. It is encouraging young people to work in both the fishing industry and in other sectors. On the other hand, the processors in site 2 have acquired skills from migrant dried fish processors from neighbouring districts of West Bengal and started practicing the same to expand employment and income opportunities. They are now compensating the effort with a higher amount of by-catch and small fish, about which they were not very concerned earlier.

The lower end value chain actors are adopting corporate value chain integration models wherein they are trying to reduce externalities by investing in all nodes of the value chain, tapping the favourable national and international trade regulations in favour of mechanized fishing, and

creating processing and export facilities. For example, Falcon Marine exports, India, having a base in Odisha, has investments in the entire fish value chain, including inbound logistics.

The widespread practice in the dried fish market space is what is known as "adjusted vertical integration." Such practice allows one of the value chain actors, mostly the wholesalers and traders, to exercise greater control over the value chain through the engagement of commission agents and middlemen. They also control the marketing infrastructure through membership-based cooperatives. Many fishers and small-scale processors are not allowed to be members of the cooperative due to low volume of production, identity, and access issues. While all the fishers are members of the Kharinasi (site 1) and Kirtania (site 2) boat associations, the processors do not have membership in the fisheries association. There has also been a growing incidence of horizontal integration, mostly between banks, the financial sector, and the insurance sector. Such integration is mostly financial in nature. Additionally, it has been noticed that there is an increase in investment towards safeguarding the procurement base through advanced payment, deploying area and species-specific commission agents, and improving the quality of the produce.

3.6. Conclusion

The SESDFVC approach paints a novel perspective where the value chain structure, conduct, and performance need to be reimagined with a new set of attributes and factors influencing horizontal and vertical interactions in the value chain (Pradhan et al., 2022). The nonlinear interplay of knowledge, technology, policy, biological flows, customary norms, and social interactions, blurred division in actor roles are critical features of the dried fish value chain in the Bay of Bengal region (Belton et al., 2018; Pradhan et al., 2022). It is evident that the resource system plays a critical role and has a stronger influence over both the production, market, and labour dynamics in the DFVC (Belton et al., 2018; Pradhan et al., 2022). There is a positive correlation between fish production and dried fish production through small scale operators, their power in the market in terms of price, access to different markets and credit structures. A historical study from Myanmar also suggests that there is a direct correlation between intensification of coastal fishing, declining catch per unit effort, and a reduction in daily quantities of fish dried by women workers (Belton et al., 2019). The empirical findings suggest criticality of considering both the capital and non-capital relationships in mapping out value chain dynamics and make compelling case for resource being a crucial value chain node.

Effective mapping of feed backs, linkages, uncertainties, and emergences within and across value chain nodes has greater implications in removing trade barriers in terms of dried fish processing infrastructure, access to fair credit systems, uptake of welfare schemes, transparency in trade transactions, greater buyer-seller interface, structured price discovery mechanisms and gender and caste-based inequalities (Adger,2006).

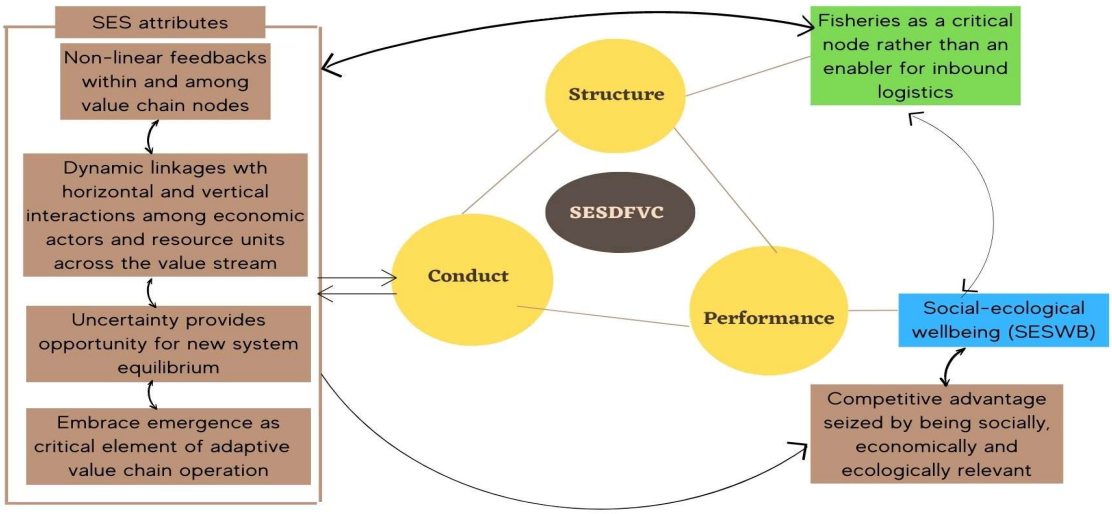

Figure 3.10: Interactions in SESDFVC

The attribute level analysis also implies that there are multiple horizontal and vertical feedback loops between and within different value chain nodes (Figure 3.10). The feedbacks are non-linear, and they have a stronger spatial, temporal, and scale dimension. The non-linear view of feedback has the potential to reimagine value chain efficiency and effectiveness pathways that are critical for ideal value chain conduct. The departure of thinking from profit and market logic to system logic that involves social, economic, and ecological interactions provides a comprehensive understanding of place based and actor-based issues in a disaggregated manner. This has greater implications for analysing the issues and structural barriers with upper end value chain actors and enabling them to participate in the value chain decision making process.

Scholars working on pro-poor value chains consider the power of the poor in the market and their active participation in the value chain the most critical aspect of the value chain's functioning. The lack of access and agency of the poor often serves the interests of people in power (Arthur et al., 2021). DFVC is also witnessing fuzzy boundaries across the nodes, and the interactions among economic agents are evolving on a temporal and spatial scale. Conventional

value chains, in their quest for risk minimisation and efficiency, often fail to appreciate such dynamism and tend to promote vertical integration. The adjusted vertical integration limits the scope of upper end value chain actors to participate in the value chain as equals. However, the SESDFVC provides an analytical framework for capturing dynamic nature-human interactions e.g., species availability, habitat characteristics, implications of other conservation priorities, enhanced frequency and intensity of weather events, social and market interactions. Such an understanding is useful to develop strategies for ensuring social-ecological wellbeing of value chain actors.

Another way to look at this system connection from an ethics and justice perspective, a critical pathway for achieving environmental and social sustainability (Nayak et al., 2021). Redress of social inequalities and improved access to resources can enhance the actors' ability to benefit fully from their participation in the value chain (Belton et al., 2018; Blanchet et al., 2006; Jansen, 2013). SESDFVC analysis provides for greater discussion on justice in terms of access and interactions with both the ecosystem and affected human communities through a multi-scalar perspective. The study region is exposed to a high level of uncertainty associated with natural hazards and market and policy processes. Conventional value chain processes are tuned towards engaging with uncertainties through a risk minimisation framework governed by organisational and supply chain efficiency logic (Pradhan et al., 2022; Simangunsong et al., 2012). In contrast, a SESDFVC recognises uncertainty as a critical attribute that reflects emergence and makes the system adaptive to constant change. Competitive advantage is seized by being culturally, ecologically, and socially relevant. Therefore, SESDFVC is better placed to promote community stewardship and attain sustainability standards and certifications such as MSC (Marine Stewardship Council) or ASC (Aquaculture Stewardship Council). Such certification has the potential to strengthen reinforcing feedback loops by incentivizing fair trade practices.

Further, empirical findings from attribute level analysis provide for a renewed understanding of "value" in the dried fish value chain from the perspective of upper segment actors. SESDFVC places higher importance on the material, relational, subjective, and ecological wellbeing concerns over a narrow financial value framework. Therefore, the material, relational, subjective, and ecological wellbeing hold greater importance over mere financial return as value. The next chapter unpacks the understanding of value and attempts to discuss the ways of value creation that is shaped by contextual interactions of social, economic, and ecological variables.

Chapter IV

Reimagining “value” as social-ecological wellbeing in dried fish value chain

4.1. Abstract

Small scale fisheries research has demonstrated that interactions in fisheries operation is not just limited to economic relationships. In fact, a sense of place, local ecological knowledge, different cultural and social values, sector- and community-specific governance arrangements, and gender, religion, and other social markers of diversity that are woven together with economic practices. Yet, the literature on dried fish value chains paints a neo-classical economic narrative with financial flows as the main definition of value. The neo-classical economic value chain paints the poor and vulnerable fishers and small-scale processors, who operate at the upper end of the value chain, as non-significant players in value chain decision-making processes. This chapter provides an empirical case for reimagining “value” and value chain performance in dried fish value chains by using a hybrid framework of social-ecological wellbeing. This hybrid framework considers both the theoretical understanding of social wellbeing and social-ecological systems (SES). In contrast to the utilitarian perspective of commodity value chain, which is governed by subjective individual choices, the paper provides a wider understanding of value in SES oriented dried fish value chain as social-ecological wellbeing. The narrative of “value” in SESDFVC offers a wider meaning that appreciates diverse ways of value creation which is shaped by contextual interactions of social, economic, and ecological variables.

4.2. Introduction

Value is perceived differently across different scholastic disciplines. “Values" are enduring ideas that people find desirable as they guide their decision-making and behaviour (Brown, 1984). They are believed to have a variety of effects on a person's beliefs and actions. Values are "the principles or standards of behaviour; one's judgement of what is important in life." Value is essentially seen as social capital, social power, influence, public image, belongingness, confirming to social and cultural processes and recognizing community belongingness (Ferguson et al., 2022; Song & Chuenpagdee, 2015).

In the conventional commodity value chain approach, value is perceived as financial gain (Belton et al., 2022; Pradhan et al., 2022). Such a neoclassical economic understanding of value undermines the intrinsic meaning of the commodity as it focuses on the marginal utility derived from the exchange of commodities across nodes and segments of a value chain. In the commodity value chain, "value" is considered as the commodity's ability to produce economic benefits (Taylor, 2001). Interdisciplinary scholars have contested the narrow neo-classical economic perspective of the commodity value chain for natural resource products like dried fish (Fabinyi et al., 2018; Johnson, 2017). They look at value as a multidimensional construct that reflects capital and non-capital relations that are contingent upon specific histories, ecologies, peoples, place and the practices therein (Ferguson et al., 2022; Fabinyi et al., 2018; Ruddle & Ishige, 2010; Ahmed & Lorica, 2002).

The commodity value chain with a neo-classical economic orientation ignores the processes and relationships that determine the production of a commodity (Fabinyi et al., 2018; Ferguson et al., 2022). In the context of dried fish, the production system is quite dynamic and woven into strong social and ecological relationships. Within a marginal utility framework, values are mostly orientated towards individual choices which fails to appreciate the broader perspectives of value that are multidimensional and underlying motivations for a particular choice (De Vries & Petersen, 2009). Further, a lack of consideration of multidimensionality of value in dried fish value chain policy and investment hinder the identification of appropriate responses pertaining to complex social, ecological, and institutional interactions across multiple scales (Ericksen, 2008; Marshall, 2015).

The objective of this paper is to examine "value" in the dried fish value chain from a social-ecological system perspective. The research is situated in a dried fish context in the Bay of Bengal region of Odisha and West Bengal, India. The analysis of value is done by using a hybrid framework of "social-ecological wellbeing" (SEWB) that has consideration of both the theoretical understanding of social wellbeing and social-ecological systems (SES) (Brueckner-Irwin et al., 2019; Nayak & Pradhan, n.d.; Pradhan et al., 2022). SEWB has conceptual grounding in the dynamic linkages between human interests and ecological processes where they represent the social and ecological sub-systems respectively (Armitage et al., 2012; Coulthard et al., 2011). The SEWB perspective provides for multiple material, relational, subjective, and ecological attributes by which people draw meaning for their engagement with the fisheries

social-ecological system (Brueckner-Irwin et al., 2019). The recent work by Pradhan et al. (2022) further highlights several advantages of analysing the dried fish value chain through SES attributes. In fact, this approach is helpful to attach importance to the role of upstream value chain actors as active participants in the value chain, rather than as mere suppliers of inputs. Based on empirical case studies in Coast of the Bay of Bengal, this analysis offers an understanding of how upstream value chain actors perceive value in dried fish value chain. This chapter further analyses how the SES orientation to dried fish value chain contributes to visualising "value" as contributions to wellbeing of the upstream actors.

4.3. The conceptual framework

In theory, the "value" in a value chain is often takes on a neo-classical economic definition where value is equated as marginal utility and satisfaction for consumers (Taylor, 2001). Neoclassical economics considers value as a function of an individual's subjective preference and the commodity's value as accruing through exchange in market. The neoclassical construct of commodity is mostly guided by consumption behaviour and incentives in the chain processes to foster individual choice of consumers (Floey, 1999). Fisheries supply chains have often used the concepts of product, price, place and promotion (De Silva, 2011). A *product* signifies the physical product in the form of marketable goods where the product's life begins with its entry into market chain. *Price* is about the selling price of product that is guided by the profit orientation and competitive price advantage over the competitors. The *place* aspect is considered for ensuring competitive advantage and geographic distributions by making channels of distribution efficient and cost effective. *Promotion* is about the strategy of communication between market actors and consumers.

These four Ps have been considered inadequate as they can operate through a push factor by manipulating demand through aggressive promotion strategies (De Silva, 2011). Recent work on value chains has expanded this 4P orientation of decision-making to seven Ps by adding three other critical aspects such as people, process and physical evidence to accommodate the growing demand of service economy (De Silva, 2011). The *people* aspect brings in the strong labour dynamics, efficiency, and effectiveness issues for improved service delivery to maintain the consumer base. *Process* feature highlights the importance of the process by which the service or commodity is delivered to maintain profit margin without compromising on customer satisfaction (De Silva, 2011). These value chain narratives are primarily guided by the central

objective of profit and making the market exchange process more efficient and effective. The centrality of decision-making lies in what utility the lower segment value chain actors derive from the exchange of commodity across different value chain nodes. The value creation process is generally unidirectional. It also fails to acknowledge diverse ways in which value is generated for value chain actors at different nodes, particularly by fishers and dried fish processors in the upper segment actors, (Belton et al., 2018; Pradhan et al., 2022).

The neo-classical economic construct has been under intense scrutiny by interdisciplinary scholars as they perceive market as an embedded system within the larger social system. Understanding the diverse ways in which value is conceived and shaped is essential for comprehending the forms the dried fish economy takes and the ways in which it is governed. Values can be deeply held in people's reasoning. It helps relate to other cognitive constructs like knowledge and mental models, which guide life goals and life satisfactions (Berenji et al., 2021; Jones et al., 2016; Schwartz, 1992). Values are also discussed as dynamic influences within the fisheries system as it shapes cognitive constructs of better world, good life, personal virtues, and outward aspirations (Berenji et al., 2021; Song et al., 2013). Better world value propositions call for human behaviour and action towards welfare of all and conservation of resources for the peaceful living and sustainable livelihoods (Berenji et al., 2021; Song et al., 2013). A 'good life' is about fulfilling the innate desire of life satisfaction that is influenced by both individual and societal attributes. (Csikszentmihályi, 1990). "Good life" recognizes the self through an emphasis on personality, hopes, fears and aspirations as well as by attributing meaning to experiences (Weeratunge et al., 2014). Such behaviors drive the individual to derive positive affect from learning new things, using one's skills, feeling respected, and garnering appreciation by others (Ryan & Deci, 2001). "Personal virtue" refers to the values that are derived from positive and cooperative social relations within the family as well as other individual relational aspects and personal contact. In the context of fisheries system, other aspects generate value such as the act of benevolence and welfare of family and peers, respect of societal rules, honesty in practice, mutual support during situations of resource constraints and financial stress and climate uncertainties. Outward aspirations indicate the value that is created through desired relationships with the outside world (Berenji et al., 2021). Therefore, value in the value chain context needs to be visualized within the framework of cultural specificities, relational identity and non-capital exchange relationships beyond the market exchange framework of value chain (Belton et al.,

2022; Fabinyi et al., 2018; Pradhan et al., 2022). The question of relationality underpins the new meaning of value of a commodity where it is derived through its relationships with people and environment in which it is produced. (Johnson, 2017; Thompson, 1991).

The dried fish value chain is diverse and operates on the relational principle that "if there is no fish, there is no dried fish." Pradhan et al. (2022) have analysed the dried fish value chain from social-ecological system considerations – a SES orientation perceives value chains as dynamic, non-linear, co-evolutionary, and ultimately, constitutive of linked social and ecological processes that are "co-productive" enablers (Pradhan et al., 2022; Marshall, 2015). In contrast to the conventional value chain, the SESDFVC framework proposes a novel framework for understanding the value chain. It recognizes the fish resource as a critical node, not simply an input for value chain inbound logistics (Pradhan et al., 2022). Such a value chain understanding helps redefine the role of resources and actors interacting with those resources in the value stream. It establishes the higher importance of upstream actors, including fishers and small-scale dried fish processors, and their dynamic interactions with the resources and value chain actors operating across the nodes of value streams.

The SESDFC framework argues that the value perception for the upstream actors connotes a wider meaning of social-ecological wellbeing of upstream value chain actors. Scholars on social-ecological wellbeing, have advanced the social wellbeing framework with explicit considerations of resource system conditions and ecological outcomes (Armitage et al., 2012; Brueckner-Irwin et al., 2019). Social wellbeing is defined as "a state of being with others, where human needs are met, where one can act meaningfully to pursue one’s goals, and where one enjoys a satisfactory quality of life" (Gough & McGregor, 2007). They characterized wellbeing in a three-dimensional framework that includes material, relational, and subjective wellbeing. The social wellbeing framework is quite evolved in terms of understanding diverse ways of value creation with adequate attention to context specificities and interactions with the resource system (Coulthard et al., 2011; Weeratunge et al., 2014). However, recent research has shown that social wellbeing may not necessarily recognize the ecological and environmental factors that are instrumental in achieving sustainable outcomes. Because human life is not compartmentalized, full realization of one’s wellbeing will depend on social-ecological realities and conditions in an integrated way. (Brueckner-Irwin et al., 2019). Hence social-ecological wellbeing adds an ecological dimension to the material, relational, subjective dimensions of social-wellbeing framework (Figure 4.1).

The framework helps to map the attributes and perceptions of upstream value chain actors. In turn, this helps to examine the broader conception of benefits they derive from being a part of the human-environment system (Brueckner-Irwin et al., 2019). The inner circle suggests the dimensions and the elements outside the circle are attributes of each dimension.

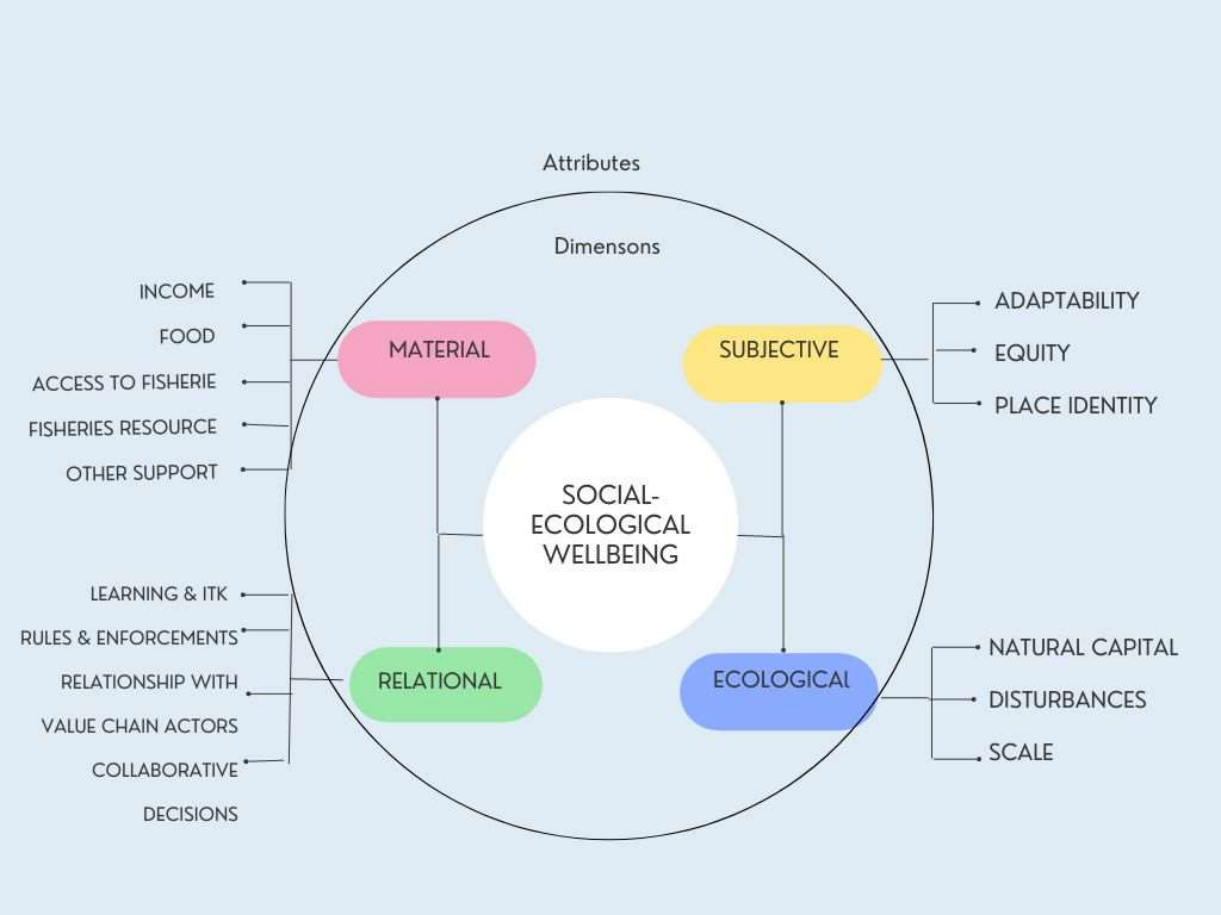

Figure 4.1: Social-ecological wellbeing; modified from the SESWB framework by Brueckner-Irwin et al., 2019.

Material wellbeing is achieved through the fulfilment of tangible and physical needs of individuals in relation to what they already have. Such needs are met through income, livelihoods, assets, shelter, food, and other physical resources (Coulthard et al., 2011; Weeratunge et al., 2014). Hence, in the dried fish context, fisheries and access to fisheries are central to income, livelihoods, and food security. Similarly, access to the market provides an opportunity to enhance income and employment opportunities for fishers and dried fish processors. In addition, in a subsistence economic setting, appropriate welfare support schemes

and easy credit options plays a greater role in reducing income vulnerabilities and meeting the physical needs of fishers and dried fish processors. Relational wellbeing refers to the value derived from existing relationships and interactions with people and institutions. In fishing, people find meaning in collaborations, social obligations, rules, social learning, and traditional knowledge systems (Baker et al., 2021; Belton et al., 2022; Brueckner-Irwin et al., 2019; Song et al., 2013; Weeratunge et al., 2014). The subjective dimension of wellbeing explains how individuals find meaning in life satisfaction and how they perceive and make sense of life (Kahneman & Krueger, 2006). Subjective well-being delves into behavioural aspects like identity, equity, and adaptability that are highly place-based and context-driven. Drawing upon the ecological resilience thinking, Brueckner-Irwin et al. (2019) outlined three critical ecological attributes including scale, disturbances and natural capital. They significantly impact the flow of benefits to the resource communities. In the context of this research, fishers and dried fish operators constitute resource communities.

4.4. Methodology

This paper was developed through a mixed method research approach. The research drew insights from multiple theoretical lenses to derive a novel understanding of "value" in the dried fish value chain through a pragmatic research design. The pragmatic paradigm allowed to have an antirepresentational view of knowledge that focuses on the notion of utility and a flexible research process. From an epistemological standpoint, an antirepresentational view accommodate dynamism in cognitive science and it provides relational interpretation of perceptions (Yvonne Feilzer, 2010). Thus, a mixed method approach has been adopted by combining both quantitative and qualitative methods (i.e., village survey, semi-structured interviews, content analysis and participant observation) to draw coherent inference from complexities of views and participants operating at the different nodes of the value chain. Furthermore, it offered us flexibility to incorporate iterative and collaborative methods to seek answers to problems that are strongly entrenched in community context, behaviour and practice (Cresswell and Cresswell, 2017).

The field research was implemented using a case study approach that provided a comprehensive, holistic, and in-depth investigation of the dynamic dried fish system within its context, and a dedicated focus on the perspectives of the actors across value chain nodes (Creswell & Creswell, 2017; Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014). The case study approach has

also helped in employing different tools to collect and analyse data that are mutually informative and provide a more synergistic and comprehensive view of the dried fish value chain (Harrison et al., 2017; Yin, 2014). The case study was conducted in two locations on the eastern Indian coast of the Bay of Bengal, having dried fish value chain connections in Odisha and West Bengal. The sites were strategically selected for their diverse social-ecological characteristics. The first sites, Kajalpatia and Batighar villages in Jagatsinghpur district, are situated near the Bhitarkanika national park. It has the unique attributes of a large estuarine area and a rich floral and faunal diversity with conservation regulation. While the area is a habitat for IUCN red listed-species like sea turtles, crocodiles, and rare species of white crocodile, besides having a rich mangrove forest, it is also inhabited by Bengali fishers who permanently migrated from West Bengal and Bangladesh between 1920 and 2000. Only four families are early settlers who belong to the Odia community, and they hold the political and social power in the village. The second site is NM Padia village in the Balasore district of Odisha, inhabited by fishing communities organized by caste. Though the site belongs to Odisha, fishing and trade relationships are mostly with the Digha-Mohana market of West Bengal. The practice of drying by the native fishers in NM Padia is relatively new. The communities have learned the drying technique from the migrant fishers from West Bengal who used to camp in the area for five months a year. However, with growing interstate vigilance and natural calamities, the annual migration of Bengali fishers ceased, and local communities continued the practice.

Considering the complex dried fish social-ecological systems in the study locations, we used a village survey, semi-structured interviews of fishers, dried fish processors and traders, as well as a participant observation method for primary data collection. Data collected from secondary sources and through a scoping literature review along with primary data informs the analysis presented in the paper. Table 4.1 below describes the methods used to inform the analysis.

Table 4.1: Methods

Methods	Description
Literature review	The scholarly work on the dried fish value chain is limited. A lion's share of the literature is on technical aspects, mostly nutritional and hygiene analysis of dried fish (Belton et al. 2022). Therefore, strategic investigation through targeted search of research questions was conducted in related literature to enhance the scope of analysis beyond dried fish literature. For scoping review, Scopus, Science Direct,

	and Jester databases were searched. Along with this, a specific search was performed to locate articles that are relevant to the research topic. The scoping was done with the objective of finding references for a) the case study context, b) the theoretical framework (value chain, social-ecological system, and social-ecological wellbeing), and c) the research question (value perspective in value chain).
Village survey	A census survey was conducted to obtain critical input and elements that informed the strategic enquiry through semi-structured interviews. SES oriented dried fish value chain is a less studied area. The village survey helped in identifying critical value chain nodes and processes. It also helped to form a robust idea of the social-ecological setting of the production relations of the dried fish, which is as critical as the product itself. 100 households were surveyed at two field sites
Semi structure interview	68 semi structured interviews were conducted, including various categories of value chain actors with a greater emphasis on upper segment value chain actors that include fishers and small dried fish processors. The sampling is relative to the number of actors operating in the study area and reliant on the objective of research to situate the value chain analysis in a social-ecological system (SES) perspective. SES calls for a place-based and contextual understanding of human-nature interactions and, in the case of the dried fish value chain, "fisheries resources" is considered an important node. Hence, greater emphasis was placed on understanding the value chain dynamics from the perspective of fishers and dried fish processors, who often have mixed identities. The small-scale fishers also work as dried fish workers and dried fish processors. Some of them even spend some time as dried fish commission agents. Out of a total of 68 respondents, 40 (59%) are fishers; 20 are dried fish processors (29.5%); and 8 are traders (11.5%). The interview questions aimed to develop deeper place-based understanding of (a) SES attributes in relation to dried fish value chain (b) social-ecological wellbeing (material, relational, subjective and ecological) dimensions of dried fish value chain.
Participant observation	The researcher spent considerable time over three dried fish seasons in the field study locations. This extended stay helped to record the behaviour and activities of dried fish actors, particularly fishers and dried fish processors, and their collectives. The observations are mostly open-ended and guided by free interactions with the research participants at the study site. Diligent field notes were prepared, and photographic evidence were collected during the field work schedule. Such notes were analysed with data obtained through village survey and semi-structured

	interviews to draw meaningful inferences.
Secondary data collection	Secondary data used in this study was obtained from published and unpublished sources. Unpublished sources mainly included fisheries department statistics, outcome budgets, and mandi records. The published sources included fisheries handbook; websites of national disaster management authority, state disaster management authority, Central marine fisheries research institute, Central Institute of Fisheries Technology (CIFT), Marine Products export development agency (MPEDA), Department of fisheries and animal resources of the government of India, government of Odisha, and government of West Bengal.

The SPSS software helped the data analysis process by combining qualitative coding and descriptive statistics. The research adopted a mixed coding approach involving both deductive and inductive coding as an iterative approach. In contrast, the literature review followed an inductive coding method, which includes an exploratory approach to build the novel theoretical framework. The field data was treated with a mixed coding approach. The initial coding categories corresponded to the broad themes determined by SESDFVC conceptual framework and social-ecological wellbeing (material, relational, subjective, and ecological) parameters. Further new codes were assigned during content analysis of the data obtained from the survey and semi-structured interviews. While coding qualitative responses, different values were assigned to different segment of responses. The responses from fishers segment were coded as F1..F40, processors as P1..P40 and traders as T1…T8.

4.5. The empirical pursuit of value in the dried fish value chain

In the study region, the dried fish operation is dominated by self-employed household enterprises, where the upstream actors often have mixed identities as fishers, dried fish processors, dried fish workers, aggregators, and sometimes retailers as well. Therefore, their value proposition has a multidimensional perspective as outlined in the attribute framework of social-ecological wellbeing (figure 4.1). We have examined material, relational, subjective, and ecological dimensions with sixteen corresponding attributes to analyse value in the SES-oriented dried fish value chain (Figure 4.1).

4.5.1. Material wellbeing dimensions

The fishers and dried fish processors engaged in the dried fish value chain associate higher value with fisheries resources as it determines their lives and livelihoods (Nayak et al., 2021, Bene, 2006). The dried fish operators have mixed identities. 69% of the respondents (n=110) reported having mixed identities such as being fishers, boat owners and dried fish processors. We define mixed identity as the multiple, overlapping, and simultaneous roles which actors play within a value chain indicating their capacity, interest, and agency. Household income and employment is contingent on how the mixed identities contribute to the income basket. Within a subsistence economic setting, access to fisheries and the heath of these fisheries resources determines sustenance of such livelihoods1 basket.

All the respondents highlighted the urgency to protect resources through reducing catch per unit effort (CPUE). Their concerns for sustenance and good life can be better understood through the following expressions by the respondents. They used a "rice pot" analogy to depict the importance of rivers and the sea as sources of food, income, and livelihoods for fishers and dried fish operators.

"The sea and rivers are our rice pot. We will survive only when the sea is protected. But we are worried now. Many people who are not fishers have entered the fishing business. They are destroying our rice pot. We are suffering and are pained to see the abuse of sea." (Respondent no F3; a fisher cum dried fish processor from site 1)

At both the study sites, most of the respondents expressed the need for protection of the resources. However, 97% of fishers (n=20) from site 1 expressed their unhappiness with the reduction in the number of legal fishing days due to various fishing bans in the estuarian and territorial waters. Table 4.2 outlines various types of fishing bans, and their implications on communities in the study sites.

Table 4.2: An account of fishing ban and its impact on upstream value chain actors

Types of fishing ban	Purpose	Enforcement authority	Regulatory provision	Impacts
Winter conservation fishing ban	Conservation of nesting and breeding	Forest and Environment department and	Fishing ban within 20 kms from the coast for 7 months across 125 kms of Odisha	Disproportionate livelihoods stress on artisanal

	ground for Olive ridley turtle	fisheries & Animal resources department, Government of Odisha	coast (1st November to 31st May)	fishers in Kajalpatia and Batighar
Monsoon fishing ban	Replenishment of fish stock	Fisheries department	Ban extends up to 12 nautical miles for two months (15th April to 15th July). Traditional fishers with boat size less than 8.5 meters are allowed to carry out fishing in territorial water	Double whammy for fishers as monsoon ban follows the long winter ban.
Marine protected area conservation ban	Conservation of wildlife	Department of forest and environment, Government of Odisha	Year-round ban in fisheries in Bhitarkanika national park	No access to fishing resources and low surplus for drying.

According to communities in Kajalapatia village (site 1), such fishing bans along with the increased frequency of extreme weather events are causing a significant reduction in fishing days. This results in increased households concerns about livelihood in terms of loss of wage, employment, and income. Though fishers and dried fish operators are in favour of the monsoon ban to protect breeding stock in the sea, they are quite sceptical about prolonged fishing bans. Fishers also believe that the fishing ban does not contribute to the desired conservation goals. On the contrary it, they believe it accentuates the problem because it creates a mad rush to catch any available fish during the post-ban period using gill nets and with bottom trawling practice.

The complex fishing ban regime with differential provisions for traditional, mechanized, non-mechanized and motorized boats also created an environment of mistrust and manipulation. Though the bans intend to protect the interests of the artisanal sector during the monsoon ban, they suffer from loopholes. In fact, many large boat owners, who also own smaller boats, take advantage of these legal provisions. As a result, the competition has increased and fishers are resorting to intensive fishing practices by using gill nets and bag nets. The forest department and marine police have a rent seeking behaviours such as demanding bribes and undue favours. Their

increased presence have created a sense of insecurity among dried fish operators who double up as fishers. The following statement of two respondents from study villages testify to the change in fishing practices due to technology upgrades, intensive fishing and its negative impact on material value ascribed to the fishers and dried fish processors.

"Earlier we were not bothered about small fish. We were catching good quantity of large fish and earning good money. It is even hard to recover the costs of gas and labour through day trips as many motorised and mechanised boats are competing for the same fishing space. Now we are forced to catch whatever is available and engage in drying of non-edible trash fish to meet our survival needs". (F 31, A fisher and dried fish processors from NM Padia village (site 2).

"In my younger age, during one blue moon period, I harvested seventy sacks of fish in one day. But now it is a dream. Sometimes in a fortnight, it is difficult to have such kind of catch." (P19; A fisher with 52 years of age in site 1).

While maintaining stable incomes and livelihoods remains a challenge, respondents also voiced concern about food and nutrition security. As outlined in table 4.3, the dried fish produced in the study locations have high nutritional values. Dried fish is a concentrated source of animal protein, essential micronutrients, fats which are beneficial to the immune system and muscle building functions (Kumari et al., 2021; Mallik et al., 2021).

Table 4.3: Nutrition analysis of commonly used dried fish species.

Local name of the dried fish	Scientific name	Nutritional content of dried fish			Value for local fishers and dried fish processors
		Carbohydrate	Protein	Lipid	
Chauli (Indian anchovy)	Stolephorus indicus	32%	82%	76%	100% of respondents, including fishers and dried fish processors consider dried fish as critical source of nutrition and food
Phasa/ Tampra (Gangetic hairfin anchovy)	Septinina phasa	16.2%	60.9%	59%	
Olei (gold spotted anchovy)	Coilia dussumieri	17.4%	59%	53%	
Kharpani (oil sardine)	*Dussumueria acuta*	14.9%	52%	58%	
Baligarida	Glossogobius giuris	19.2%	63%	69%	

(Source: Kumari et al., 2021)

These nutritional benefits are well corroborated by local practices. The following account of a female respondent from site 2 explains the food and nutritional value of dried fish.

"We get strength to work round the year by eating fish, crabs, and dried fish. We can not manage without that as we do not have suitable land for growing several types of vegetables as substitutes. During cyclones and harsh weather conditions, dried fish and rice are the most important food for us (Respondent P5: A woman from NM Padia)."

Respondents from various nodes of the dried fish value chain provided a multidimensional narrative of dried fish in relation to household food and nutrition security. Table 4.4 outlines the diverse ways communities perceive the interactions between dried fish, household food and nutrition security. While all the respondents consider dried fish to have a critical consumption value, a significant percentage of respondents stressed the indirect influence of dried fish operation on food security. In fact, it provides employment and income for 10 months even during the winter fishing ban. The self-employed household dried fish processing enterprises manage their operations by participating in 'C' class fish auction of catch by trawlers and sona boats.

Table 4.4: Community perception on food and nutrition perspective of dried fish

Perspectives on food and nutrition	Percentage of endorsements by research participants	Source of data
Consumption for good taste and can be eaten with rice without any additional side dish.	100%	Village survey (n=110)
Availability during food stress period	100%	Village survey (n=110)
Income from dried fish operations used for buying food	73%	Village survey (n= 110)
Dried fish provides food and employment for 10 months even during winter fishing ban (buy c class fish from trawlers)	53%	Semi-structured interview of fishers and dried fish processors (n=60)

Fishers, dried fish workers and small-scale dried fish processors gave mixed responses when asked about the other government support to deal with income, employment and environmental vulnerabilities. At site 1, people complained that the government compensation for the fishing ban is too low compared to the loss of livelihoods. The compensation amount is a one-time payment of INR7,500 ($100 USD) per fisher family for the entire seven-month fishing ban period. Many of them are not able to take advantage of various other social security schemes related to food security, housing, and savings-cum-relief schemes due to lack of land tenure, domicile issues, and procedural bottlenecks. For example, only sea fishers are eligible for accident insurance. Such a measure excludes dried fish processors and women workers who do not go sea fishing from accessing the social benefits. The results of semi-structured interviews of fishers reveal that in the study site 1, about 25% of fishers (n=20) are deprived of marine identity cards in the absence of proper domicile documents. Contrarily at site 2, people enjoy the benefits of food security schemes because they all have marine identity cards. However, frequent cyclones often cause unrecoverable loss of fishing stock and fish drying infrastructure. In fact, after cyclones Fanni (2019), Amphan (2020) and Yash (2021), the small-scale dried fish processors temporarily stopped operating as they could not fully recover and rebuild the lost infrastructure.

The traders also voiced their concerns about the increased pressure on the fisheries system and declining CPUE. There have observed difficulties in obtaining dried fish at a reasonable price and maintaining a reliable supply. Predictability and dependability in supply are critical attributes for cost effective inbound logistics. The cost efficiency in inbound logistics has a positive impact on pricing and profits. 60% of respondents from the traders / wholesalers' node (n=8) in both field sites expressed that the cost of procurement has now substantially increased. They also pointed to the timely availability of quality products of desired species as an important attribute. As such, they need to maintain higher stocks in warehouses to hedge unpredictability in the supply chain. This is a complex process as it involves additional investments with regard to sorting, grading, and managing low-quality dried fish. Overall, this has a negative impact on sales and profit.

On the other hand, with improved connectivity and product mobility, the multiplicity of procurement sources helps price competition. In addition, the opening of new markets for livestock, fish feed, frozen and processed fish has not only minimized loss from damage, but it

has also reduced competition. In fact, several traders have diversified into new businesses involving other fish products. Access to international markets has also improved due to favorable export-oriented trade policies on fish and fisheries products in Asian countries. Traders in India can now easily tap into the dried fish market in Bangladesh, Nepal, Myanmar, Thailand, and China. For example, in Sunakahala market of Odisha, the number of dried fish wholesalers and traders has reduced to 8 from 14 over the last 10 years. However, six traders have opted for new specialized roles as fish mill and animal feed suppliers, commission agents for fish processing industries, and input suppliers to aquaculture farms.

4.5.2. The relational wellbeing dimensions.

"Value perception" is strongly built through an individual's interactions and achievements through relationships and interactions with others. The identity of upstream value chain actors (fishers and small scale dried fish processors) are deeply entrenched in the caste structures. They are also highly influenced by traditional knowledge systems which evolved through their social-ecological interactions with fellow communities, value chain actors and the fisheries resource system (McGoodwin, 2001; Onyango, 2011).The study finds that strong social ties as depicted in Table 4.5 help the artisanal fishers and dried fish processors cope with growing climate uncertainty, reduced catch per unit and an identity crisis specific to several fishers in Kajalapatia village.

Table 4.5: Relational wellbeing dimensions of upstream actors

Relational dimension	Positive contributions to fishers and dried fish processors	Negative contribution to fishers and dried fish processors
Fellow community members	Stronger socio-political identity, strong culture bound norms, sharing of labour, capital and space, cultural amelioration.	Competition for space, low catch per unit
Boat owners and crew members	Partnership, employment opportunities, sharing of resource	Higher labour mobility of crew members, increasing cost of operations
Trawlers/ mechanized sector	Availability of C class species for year-round drying except during monsoon ban	High competition, low catch by artisanal fisher due to bottom trawling, increased incidences of damage to gear and net, marginalization of artisanal fishers and dried fish processors' voices, high bycatch

		resulting in low availability of fish for processing by self-employed dried fish processing enterprises
Commission agents	Enhanced access to market, higher assurance level in terms of revenue flow.	Low share in consumer rupee, blurred geographic advantage and breaking down of niche market phenomena with greater mobility of produces.
Traders and wholesalers	Access to market and advances to meet the operational costs and household requirements.	Greater mobility of produces blurring the traditional patron-client relationships. Higher volatility in price as traders have better access to information than the fishers and small-dried fish operators
Policy actors	Regulations of fishing in artisanal area by mechanized sector and by fishers from other states	Conservation ban resulting in strong livelihoods loss. Greater thrust on mechanization and industrialization resulting in loss of space and access to fishing and thereby fish processing
Credit actors / agencies	Availability of credit in the absence of formal credit opportunities	Exploitative terms of credit, debt trap and product pledging

As discussed in Table 4.5, communities in both the study locations have a greater sense of sharing their fishing grounds based on cultural norms. For example, respondents from the Kajalapatia village (site 1) reported that they have community rules governing fishing areas in the estuarine and at sea, authorized fishers and fishing periods. This ensures that all actors engage in fishing activities respectfully and without encroaching onto each other's territory. However, in the NM Padia village (site 2) fishers primarily operate in the artisanal fisheries areas of the sea and share the common fishing space without disturbing each other. 17.5% of respondents jointly own boats as they cannot afford the cost of owning individual boats. Sharing labour (*badalia*) for processing activities is a common practice in both the study sites. The small-scale dried fish operators see significant value in such collective community provisions and mutual collaborations as it helps them to cope with growing labour capital constraints.

In both study locations, dried fish operations are closely linked with traditional knowledge pertaining to fish movement, peak and low catch periods of the month, fish habitats and seasonality (and timing) of fishing during the year. The lunar cycle plays a critical role in fish availability for catch. The respondents often referred to terms such as *Uthia* (two weeks high catch period during full moon and blue moon time of the month) and padia (low catch period other than two weeks of *uthia* period) for sequencing their fishing and fish processing activities. As most of the dried fish operators have dual identity of fishers, they concentrate on fishing activities during *uthia* period and continue processing during *padia* time even though the production scale is low. For example, a respondent from site 1 explained that he migrates to Jaipur Road, an industrial town 120 kms away from his village, during the *padia* time for casual labour work. He returns to his village during the *Uthia* period to join fishing operations along with his partners who jointly own a small boat (respondent no F3). The other chain actors such as commission agents, aggregators and market players from West Bengal and southern Odisha also work in the dried fish operation based on lunar cycles to optimize their time and resources.

Another defining feature of the dried fish value chain is access to credit. Credit often determines the terms of trade and value realization at fishers and processors node. Access to institutional credit is extremely limited among our sample group. Of the 60 fishers and dried fish processors surveyed, most fishers and processors (55%) depend on informal sources of credit that include money lenders, fish traders, commission agents. A small number of respondents (7% in site 1 and 12% in site 2) mentioned they successfully received credits from bank. In both study locations, banks and formal credit institutions are hesitant to give loans to the small-scale dried fish operators. This is in part due to lack of domicile records (site 1) and the absence of payment history. The survey data revealed that about 85% of the respondents availed credit from money lenders with high rates of interest, typically between 36% to 48% per annum. The refinancing of self-help group (SHG) at a high rate of interest of 24% to 36% is also a common practice in the area. Self-help groups are neighbourhood thrift credit groups backed by national policies to shape rural life through easy and low interest credits. In the case of short-term credit, most of the fishers and dried fish processors prefer to borrow from peers and friends if possible.

Another common practice is for value chain actors, such as aggregators and commission agents, to provide annual advances to boat owners and small self-employed enterprises to secure yearly supply. Respondent DFP 1 mentioned that he gives advances to 20 boatmen annually in the

range of USD $ 8000 to 13333 (INR 600,000 to 1000000). This advance is generally given just before the beginning of fishing season when the fishers require money for repair and maintenance of boats and fishing gears. In return, the borrower must sell his produce to the lenders only at the prevailing market rate and does not have autonomy to sell his produce in the open market.

Despite stringent terms of conditions and higher rate in interest, the fishers and dried fish processors opt for the above-mentioned informal sources of credit due to easy, hassle-free, and timely availability of credit. The respondents highly value the flexibility associated with informal credit arrangements, even though fairness and ethical principles often lack in these transactions. There are varying value perceptions of credit and exchange relationships by fishers and fish processors depending on their different financial and asset holding ability. Poor fishers associate value with meeting their basic survival needs. In contrast, processors, who are economically better off, perceive credit and exchange relationships as an opportunity to keep the fishers and small dried fish processors engaged in fishing operations. Alternatively, they could move away from the sector in search of other livelihood opportunities. As Jadhav (2018) argues, the poverty narrative undervalues small-scale fisheries, their intrinsic diversity and distinct values like sharing, solidarity and informality. This last feature prevents them from the privilege of accessing the tools of the capitalistic economy like technology and finance (Jadhav, 2018).

Fishers' participation and support in governance of fish and fish products value chain is mostly analysed through the prism of fishing cooperatives. 72 percent of respondents (n=118) who are mostly from the fishing and trading nodes reported being members of fisheries cooperatives. According to fishers and small-scale processors, they become members of a cooperative with the expectation of mutual help during periods of crisis such as conflicts and natural disasters. Only about 6% of the fishers reported receiving substantial support on a day-to-day basis from the cooperative on selected issues. They have received little help when issues such as access to credit, inclusion in welfare schemes, support for human and asset loss due to increasing human-animal conflict (site 1) as well as competition against industrial actors. Some study participants also mentioned the strong disconnect between various levels of cooperatives, notedly between primary fishers cooperative and FISHFED, the apex state level cooperative. FISHFED is a state managed organization in Odisha that does not seemingly reflect the local level issues and discussions (Nayak & Berkes, 2010). Similarly, in West Bengal even though the fisheries

cooperatives are deeply rooted in the community. Some of them formed as early as 1918 during the pre-independent India, but their patronage of poor artisanal fishers and fish processors is failing and malfunctioning due to undesirable political interventions and strong elite capture (Mahanayak et al., 2017).

The recent coverage on the blue economy has further highlighted strong contradictions within the fisheries sector policy objectives and actions. The sustainable development of fisheries is mostly perceived through a sectoral view which places greater emphasis on exploitation of resources and other commercial prospects. This is done through widespread adoption of technologies like mariculture and cage farming. The Government of Odisha has initiated mariculture in the continental-shelf areas of Balasore district where study site 2 (NM Padia) is located. West Bengal has placed higher emphasis on mariculture of indicator species like Hilsa (*Tenualosa ilisha*) and on the mechanization of fishing vessels. Simultaneously, blue economy policies target mega projects involving tourism, aquaculture, mining, coastal industrialization, and infrastructure development. The industrial sector enjoys better political patronage and economic salience in the macro-economic system. The blue economy sectors and implications from fisheries threaten the viability of small-scale fishing operations that mostly contribute to the dried fish operations in the study region. 17% percent of the dried fish processors cited high industrial pollution in the artisanal fishing areas as the topmost reason for limited availability of dried fish species. Both the fishers and dried fish processors of NM Padia village (site 2) also cited major challenges such as widespread inshore and offshore activities such as prawn farming, mechanized fishing, aquaculture, etc.

In addition to the macro-development and policy challenges, the social dynamics and demographic history of the study region surfaces complex relationships among actors engaged in dried fish operation. Upstream value chain actors find greater meaning in interactions shaped by caste, language and inter-community knowledge exchange. Fishing and dried fish operation in site 1 is dominated by Bengali settlers. In the first half of the19th century, Odia landlords welcomed Bengali refugees as they served as cheap labour in fishing and agricultural operations. In the early 20th century, the area was thinly populated with vast track of forest land. The native Odia inhabitants welcomed refugees as the time because the village felt safer as its population grew. Odia fishers were organized along the caste lines and fished in rivers and estuaries. They learnt about sea fishing from Bengali fishers.

However, the social and cultural relationships have experienced periods of contestations and collaborations mostly driven by questions around access to and interactions with the fisheries system. Odia fishers faced competition from the Bengali fishers for space, which eventually led to court cases establishing fishing rights. However , Bengali fishers have lost these legal battles due to the absence of caste certificates. On the other hand, value chain dependency through the dried fish processors is higher with Bengal traders and commission agents. In fact, to protect each other's interests the Odia-Bengali fishers association known as the "Utkal Banga Suraksha Samiti (translated as 'Odisha-Bengal Security Committee) or UBSS has been formed in Kendrapada district (Chhotray, 2016). Subsequently, the macro level political and environmental external drivers established precedence in discourses on regional environmentalism. Such drivers include, the protection of eco-sensitive zones, marine protected areas, large coastal pollution and higher frequency of extreme weather events. This collaborative approach is also used to respond to the social-ecological challenges rather than engaging in conflicts to establish identity supremacy among groups. In fact, the Bengali fishers now consider themselves as full-fledged Odia residents (Raju et al., 2021). While fishers and dried fish processors from site 2 are Odisha fishers by caste, they have higher market, social and knowledge interactions with West Bengal fishers due to their geographic and cultural proximity. One of the dried fish processors said, "we had no knowledge of drying. We learnt it from the migrant Bengali dried fish processors about 30 years ago. In fact, there was no need since we had abundant fresh catch of good quality fish. Now that the catch is less and we are facing stiff competition from trawlers, we are in both live fish and fish drying business." These value relations are derived from a strong social learning perspective. Several senior fishers also noted that they value societal interactions that shape local cultures and that help them to be responsive to new physical events, emergences, fresh human encounters (Hulme, 2015).

4.5.3. Subjective wellbeing dimensions

The attributes of material and relational wellbeing in the dried fish value chain provides a wider definition of value through economic and social interactions. Subjective wellbeing recognizes people living according to their belief, with a sense of personal development, achievement and sense of identity (Allin & Hand, 2014; Dodge et al., 2012). In addition to these important factors, contextual and situational aspects such as individuals' adaptive capacity and distributional justice are important contributors to subjective wellbeing (Van Hoorn, 2007). The

identity questions and upstream value chain actors' adaptability to rapid environmental and social changes informed our understanding of how people associate value to their occupation. In the fisheries literature, there is a considerable body of work dealing with the significance of the identity of fishers and fishing as a 'way of life' (McGoodwin, 2001; R. Pollnac et al., 2012). Other research explore the importance of self-actualization as an explanatory factor for fishers' resistance to move out of fisheries (R. B. Pollnac et al., 2001). The study area offers a nuanced view of identity based on the different social-political positions that the fishing communities adopt.

Communities in Kajalapatia (site 1) dominated by Bengali settlers has a relatively more recent history of engaging in fishing than the NM Padia village (site 2). There, the fishers are identified by caste and inherit the fishing occupation from their forefathers living in the same space and customarily engaging in fishing as an occupation. The hopes, fears, and aspirations for both the communities, at individual and collective levels are quite different. The Bengali settlers in Kajalapatia are better equipped to deal with higher order of vulnerabilities, estuarine fishing, and dry fish operations. However, they always face the challenge of being treated as outsiders in the new space. One of the Bengali dried fish processors said that "we are always last to receive any support from the association and government programs as many treat us as outsiders though we are the permanent inhabitants of Odisha with all citizenship records. This is our state, and we don't have any other place to live. We live with our fellow fishing communities including both Odia and Bengalis in harmony and adhering to all rules and regulations by the fisher federation and the Government (respondent no F10)." Another fisher cum dried fish processor said that "whatever may the circumstances be, we will continue with this occupation. It gives us immense satisfaction and sense of security. During Covid 19, the young people who migrated outside in search of work came back and joined our family fishing and drying occupation." (respondent no. F6). Several external vulnerabilities have also pushed the Bengali fishers to seek greater social cohesion and safeguard their occupation space with increased responsibility and care. When asked whether they want the next generation to be involved in the fishing occupation, there was difference in opinions. Those with a greater number of boats and bigger business are interested in bringing their children into the fishing business. However, the boat workers and artisanal fishers operating with non-motorized boats are in general, not interested in bringing their children into the occupation as it is difficult to earn a decent daily living out of fishing and fish drying. This

implies that communities see dried fish and fisheries as spaces for safeguarding social-cultural identity while they have different levels of life satisfaction based on their scale of operations. Life satisfaction is about individual experiences in relation to societal and national conditions, in addition to the individual perception of his or her own life experiences (White, 2010)

In contrast, the fishers in NM Padia derive their sense of belonging from their caste identity and intergenerational skills. There, fish drying operations has a shorter history. The local fishers acquired the fish drying skill from seasonal Bengali migrants who used to camp during winter months in their area for drying low value and small pelagic fish. The Odia fishers took pridefully avoided catching such 'low value' fish because they captured large quantities of high value fresh fish that had a greater value in the live fish market. However, high competition from motorised and mechanized boats resulted in low catch rates forced them to take up fish drying activities as a survival method. 54% of dried fish processors revealed that they must spend more time at the sea to catch small quantities of fish because the catch of big fish is reducing. They are willing to adopt all options that are available to them. One of the fishers told us that, "we are born as fishers. We know this activity well. Hence, we are trying to do whatever we can to remain in the occupation. Many young people are leaving the occupation. But the work conditions outside fisheries is also not very good. They miss their families and we also miss them. What is the point in living separately from family and friend when the hardship is higher, and incomes are lower compared to if they stayed here? It is very painful. Fishing is the best thing that we know, and we should continue doing" (respondent no DFP1).

The above discussion suggests that fishing is not only associated with a sense of belongingness, but also as a space for dignified living, cultural bonding, and coping mechanisms. Other occupations such as wage labour activities and construction work, are not considered as dignified work by the fishers. Many fishers and small-scale dried fish processors are opting for wage labour work in nearby places during low catch period and joining the fishing and drying operations during high catch period (*uthia and Padia)* of the month. In case of annual migration, the data suggest that people prefer to work as crew members in fisheries operation. The successive cyclones over three consecutive years (2019 to 2021) have caused severe damage to fishing and drying infrastructure. There is hardly any time to recover between two cyclones, forcing dried fish processors to cease drying operations. They also resorted to fishing and selling live fish to traders in order pay back the loans they had taken to repair their cyclone ravaged

houses, fishing boats, gears and equipment. Reflections from several fishers suggest that they consider the entire fishing operation in its totality instead of segregating it in the value chain terms as live fish value chain and dried fish value chain. This holistic perspective of fish, fishing, fisheries, and people who engage in fishing is not only inclusive but also akin to a social-ecological systems view of value chains.

In both the study sites, the fishers continuously demonstrate they can adapt to the challenges linked with nature, climate change, state-led mechanization trends, marine aquaculture, and coastal industrialization through the blue economy approach. The different political leanings and asset holding positions also create a divide in the community. Additionally, fishers and dried fish processors in both locations have also spoken about the following emerging issues: high trawler bycatch, and discard in the sea, low landing of bycatch – which is due to the thriving sea trade among Odisha and Andhra Pradesh trawler owners with opening of market in poultry - fish feed industries and illegal catch in artisanal fisheries area. The average quantity of discard of trawler bycatch in Odisha coast range from of 67070 tonnes to 131480 tonnes per annum (Ganapathiraju, 2010). At the same time, the estimated volume of illegal catch in artisanal fisheries area along Odisha coast is between 2100 to 4000 tonnes (Ganapathiraju, 2010). Since such processes are causing serious equity concerns in the fishing space, as the artisanal fishers and self-employed dried fish enterprises are deprived of their due share. In fact, what is considered as bycatch is the valued catch of the artisanal fishers and small-scale dried fish operators (Lobo, 2018). At the same time, amidst supply challenges, 84% of the dried fish processors (n=20) are adapting to the situation by finding new market avenues in market in animal feed industries.

Furthermore, the study participants were quite vocal on the recent industrial developments and the changing social-political dynamics in their region. The region of study is witnessing massive investments on infrastructural projects including the 481 kms long Digha-Gopalpur coastal highway project, which covers almost the entire coastline from West Bengal to Odisha and the establishment of two new ports for marine mariculture, and shrimp aquaculture. Artisanal fishers with no other livelihoods or land assets (excluding fishing and fish processing) are concerned about their survival as they fear displacement and loss of occupation. Indeed, fishers value the emotional connection with the fisheries and related resources. It means more than mere employment and income avenue.

The lower value chain actors, including dried fish traders and trade commission agents, also shared concerns about the change and constant adaptations they are making to remain in the business. According to one trader, "We used to have our agents in coastal villages, and they were sufficiently supplying all types of dried fish to us. But now the scenario has changed. The production base has become highly unreliable. Hence, we cannot depend on those village level agents. With increased unreliability we are buying from both the local and distant markets. Now we must maintain stock in the warehouse (local go downs) which is adding additional cost. However, better road and telecommunication facilities are making our life easier as we can tap into different markets for cost optimization. At the same time, we are also able to tap into the fish and animal feed market to supply the low-quality dried fish which is not fit for human consumption to minimize loss. While the dried fish trade has become increasingly complex, we are also learning new ways to manage the trade" (respondent no T5, A trader in Sunakhala market, Odisha). Similar views were also shared by fellow traders in Sunakhala market, Odisha. This indicates that at every segment of the value chain, there is ongoing adaptations to changes and each learning help the value chain actors to remain relevant and active in the market. The traders in Balighai market of West Bengal suggested that they are learning new ways to maintain their identity, remain in the trade and strengthening interstate trade. The latter is made possible through the placing of trade agents in production nodes in various states like Odisha, West Bengal, Andhra Pradesh and Gujarat.

The traders were hesitant about reporting on their trade volumes as they want to maintain a low profile due to their existing government benefits, i.e., Goods and Service Tax waiver, no transit fee for interstate transportations, etc. In Balighai, the trade is highly controlled by elite traders who are in leadership positions. However, the market offers a strong business hub for small producers who operate through agents, and they get the opportunity to sell their produce at a competitive price. The traders seem quite optimistic about the future of dried fish trade. While responding to the question on what motivates them to be in the trade, the respondents offered multiple viewpoints (as mentioned below). While 80% of traders have given highest priority to intergenerational skills, knowledge and long association with the trade, all of them emphasized the new opportunities in the market system which offers new potential. Following responses substantiate to their arguments.

“In the last ten years the dried fish business has been better recognized. Specific market infrastructure for dried fish trade has been created. People from different cultures and income groups are including dried fish in their food menu. There is also growing international demand for dried fish (respondent no T2)”.

“I think dried fish market has a good future. People from different cultures and regions want to taste it. New processing technology and knowledge is available for maintaining hygiene. The only issue is that despite being a large subsector, there is a lack of a dried fish policy. But at the same time, low attention to the sector is a bliss on the taxation front and increasing gap between demand and supply. In case of formal trade policy framework, there is always a chance of a higher regionalization of produces with greater state control on mobility of the dried fish produces” (Respondent no T3).

The upper segment value chain actors, including fishers and dried fish processors, attribute value to the greater appreciation of knowledge, skill, fisheries resources, and protection of their occupational identity and access to market. At the same time, dried fish traders see the most benefits in the protection of fisheries systems for reliability in supply, volume of trade, higher product mobility and favourable tax provisions.

4.5.4. Ecological resilience dimensions

Environmental historians describe “nature as a historical actor” (Demeritt, 1994; Merchant, 1987). They believe that nature is an agent that provides a powerful message in understanding the congruence between nature and culture. Nature as an independent agency “reminds us that there are different forces at work and not all of them emanate from humans” (Demeritt, 1994, p. 163; Worster, 1988, pp. 292–293). The social-ecological system oriented dried fish value chain strongly recognizes the criticality of natural process and hence considers fisheries resource systems as an important value chain node (Pradhan et al., 2022). The natural capital, scale dynamics, disturbances and uncertainties as the key characteristics of the natural resource system have a stronger bearing on the wellbeing of the actors who are linked to the resource system (Brueckner-Irwin et al., 2019). Also, the historical and contemporary interaction of the value chain influences the behaviour and motivations of actors, as individuals in a space and time and as a part of larger collective of dried fish subsector (Brueckner-Irwin et al., 2019).

The wellbeing dynamics in the dried fish operation in case study context can be viewed from four different scales. As can be seen in Table 4.6, the multi-scale ecological phenomena are emanating from across different spatial and temporal scales. Issues in the first scale have stronger place-based influences. Indeed, identity rooted in linguistic and ethnic diversity of the communities shape the capabilities and assets relevant for upper end value chain actors. The natural capital helps determine the nature of trade relationships, the flow of ecosystem services and the ability of the upper segment actors to negotiate the process of ecological, social, and economic marginalization.

Dried fish operation at a sub-regional scale (second scale) provide an interaction of value chain actors with a broader geographic and dynamic temporal phenomenon. Increased product mobility and exchanges in the Bay of Bengal region among value chain actors both in local and distant markets has implications on the resource system on the economic drivers of change. 80% (n = 40) of the respondents from the fishers' segment and 64% of the processors (n = 20) expressed their concern over steady decline in fish production, more particularly in the artisanal fishing sector due to intense bottom trawling operations. The case study region is also witnessing a reduction of fishing days due to an enhanced frequency of extreme-weather events. The change in the resource system is causing an economic marginalisation of upper end value chain actors in the region in terms of income, employment and access to fish. The feedback from the resource system is forcing the value chain actors to innovate and adapt to the situation by diversitying their value chain portfolio. The data suggests that 60% (n=40) of the respondent from fishing node are opting for more than one value chain roles to sustain their livelihoods and identity. In the Kajalapatia village, in about 93% of households, while male members are working as fishers, female members are primarily engaged in small-scale processing activities and working as wage labourers in relatively bigger processing units in the village. 6% percent of fishing and processing households, which have additional human resources but scarce capital base, are simultaneously operating as local aggregators and traders. Women who were mostly engaged in processing activities are now going into the fishing on the boat to help their family members and minimize the cost of fishing. This has also altered the gender dynamics in the dried fish value chain. Women are now assuming greater roles in fishing, fish processing and trading activities.

At the third scale, the policies take priority and there have been strong conservation rules regarding eco-sensitive zones for Olive ridley turtle conservation and marine protected areas. In

fact, the annual monsoon ban has resulted in 7 months of fishing ban in artisanal area. While it has strong ecological benefits, the act of overfishing in exclusive economic zones (EEZ), meaning beyond 10 kms from the coastline for the motorised boats and 20 kms for the mechanized vessels, is counterbalancing the ecological gain from the fishing ban. The fishing crews of mechanised vessels who are least affected by the eco-sensitive zone ban and marine protected area restrictions have a positive view about the monsoon ban. It gives time to breathe and space for the repair and maintenance of the fishing vessels as well. One crew member commented on the monsoon fishing ban for 45-days in the following words:

"The ban is important. The sea requires some time to recoup. 45 days are even a short period for sea to heal its pain which is caused by thousands of trawlers who are ripping apart the sea with their intensive fishing trips- a crew member in Paradeep fishing harbour".

However, artisanal fishers who are facing multiple fishing bans in artisanal fishing areas have different opinion as they do not have the capital base to upgrade their vessels and gear for deep sea fishing, which is only subject to annual fishing bans.

The change in the natural capital base is resulting in a negative influence on both self-employed enterprises and the supply dynamics of different dried fish species with historical trade arrangements. The study region is subjected to these changes in natural capital base due to the expansion of aquaculture, the industrialization on the coast such as mega ports, petrochemical industries and tourism infrastructure which causes higher coastal pollution. The study region is also highly vulnerable to natural hazards, disasters, and climate change phenomena. The Indian National Centre for Ocean Information Services (INCOIS) study shows that this region has high to medium coastal vulnerability index. The frequency and intensity of tropical cyclones are also on the rise. For example, 40% of the storms in the Bay of Bengal land in Odisha and West Bengal coast (GoO, 2015; Kumar et al., 2010). The sixth assessment report of Inter-Governmental Panel on Climate Change (IPCC) also indicates a higher frequency of cyclonic storms (Bandyopadhyay et al., 2021; Langsdorf et al., 2022). The prolonged conservation ban for 7 months coupled with increased incidences of weather events have resulted in significant loss of fishing days for artisanal fishers.

Moreover, the study also reveals that climate change is causing a shift in fish habitat (Zacharia, et al., 2016). According to fishers in Kajalapatia, they are also noticing lower availabilities of

Indian Mackerel and greater catch rate of Indian Anchovy over last ten years period. The lure of global export markets has caused a higher emphasis on shrimp and frozen fish production. Attention to candidate species has resulted in higher amounts of juvenile and bycatch. The double whammy of pollution from aquaculture and higher amount of juvenile catches has caused serious damage to fish habitats and livelihoods of the artisanal fishers.

Table 4.6: Multi-scalar ecological influence on wellbeing of dried fish value chain actors

Scales	Descriptions	Wellbeing Implications
First scale	Self-employed enterprises, kin groups, linguistic groups operating in a particular geography	It is a question of identity, appreciation of intergeneration knowledge about the fishing and fisheries resource system, ecosystem services, people and negotiating with process of marginalization. Appreciate capabilities and assets that are defined by the local cultural and historical contexts of that region.
Second scale	Fish mobility and exchanges across resource geography and interactions among actors operating in different nodes of dried fish value chain	Due to the over-exploitation of fisheries, ecological marginalization results in disproportionate stress on household economy of upstream value chain actors including fishers and dried fish processors. At the same time, it is enhancing access to information, technology, labour and market which has significant bearing on price and labour relationships. Also, there is a higher amount of bycatch
Third scale	State and territorial considerations in fisheries governance	The eco-sensitive zones regulations for conservation of Olive ridley have resulted in prolonged fishing ban. In addition, the MPA regulation (Kajalapatia village) and annual monsoon ban has aggravated the situation of fishers with an almost 7 months-long fishing ban. Furthermore, the state's agenda of coastal industrialization has negative bearing on artisanal fisheries. The overemphasis on the growth of the fisheries sector through aquaculture has also negatively influenced the livelihoods of artisanal fishers who have limited land and asset base.
Fourth Scale	Global influences-climate change, export-	The study region is experiencing escalated weather events. Over last 100 years, there have been 262 cyclonic

	oriented fisheries.	disturbances including 69% depressions, 22% storms and 9% severe cyclonic storms (Barik, 2019; OSDMA, 2019). There are also evidences of habitat shift of different species due to variability in climatic as well as oceanographic parameters. Changes in migration pattern has been observed in two important dried fish species including Indian Mackerel and Oil sardine over last 50 years (Zacharia et al., 2016). According to the respondents, dried fish operators , the small-scale operators are taking months together to resume their work as most of their assets like racks, containers and sheds are often lost to such events.

The increased intensity and recurrence of natural disasters has adversely impacted small-scale dried fish processing activities. Fifty eight percent of dried fish processors said that restarting operations takes a long period of time. In fact, they take months together to resume their work as most of their assets such as racks, containers, sheds are often lost to such events. Not a single respondent has insurance to cover the loss as such products are not available in the market due to higher propensity to loss. In NM Padia village where communities faced three consecutive cyclones, namely Fanni, Amphan and Yash over the last three years, they have stopped drying activities as they have completely lost their infrastructure. When asked about their plan, the dried fish processors who also fish said that they first need to arrange resources to resume fishing operations so that they can regain earnings. These 'natural events' also often push them into a debt trap, making it even more difficult to arrange finances quickly to re-establish the drying infrastructure. The medium and large-scale processors have greater ability to recover as they have higher a capital base and access to institutional credit in comparison to the self-employed enterprises. The dried fish operators who mostly double as fishers are coping with the increasing environmental uncertainties by optimizing the opportunities available in fisheries resources and switching over to live fish businesses. Hence, the fisheries resource as an agent has a strong influence on value chain dynamics, the operations of value chain actors, and in determining the coping strategies for challenges emanating from natural drivers of change.

4.6. Discussion

The case studies presented above demonstrate that fishing and dried fish operations are symbolic of the political, ecological, and cultural identities of small-scale fishers/dried fish producers. These identities are linked and are woven into every part of the dried fish value chain. The SESDFVC emphasizes the dynamic resource context and draws attention to multiple realities and linked understandings of the social, cultural, and economic implications of the dried fish value chain over time and space. The analysis also suggests that value chain actors draw a range of material and non-material benefits by appreciating multidimensional interactions with larger societal, environmental, and ecological processes (Pradhan et al., 2022). This empirical case of the eastern-Indian coast of Bay of Bengal demonstrates various factors and practices that influence the motivation, behaviour and incentives for value chain actors operating at different scales to find meaning in engaging with the dried fish value chain. The SEWB considerations implicate critical dimensions of equity and wellbeing on poor fishers, small-scale dried fish processors and workers across the value chain as they are directly linked to the ecological foundations of those value chains. To break the trade barriers that the poor face in the value chain, there is a need to pay greater attention to equity and justice considerations (Lam & Pitcher, 2012).

Inclusive value chains and business models also call for the greater alignment with local conditions and equitable access to environmental resources, rights, responsibilities, and innovations for efficient use (Ros-Tonen et al., 2015). The critical questions that pro-poor value chains attempt to address have greater relevance if the "value" is perceived as "wellbeing", which is beyond its financial connotation and engages with wide-ranging meaning derived from subjective, material and relational dimensions (McGregor & Sumner, 2010). Questions such as "who owns/does/gets what? and "what do they do with it?" are relevant to understand the actor relationship in the value chain. The social wellbeing approach brings exclusive attention to another question: how do they experience this? This question helps those engaged in value chain decisions to reflect upon the discursive practices that are associated with the complexities of social life as experienced by actors in small-scale fisheries (Belton et al., 2018). Further, recent literature also suggests that changes in ecosystem processes, structures, functions and services cause redistribution of wellbeing benefits among the stakeholders (Selkoe et al., 2015).

Fishers in the study area have mixed identities as fishers, dried fish processors, and dried fish workers within the fisheries value chain. The cultural and caste identity help them to operate in the value chain according to the local contextual conditions and opportunities. Therefore, the question of adaptability, equity and identity are closely linked to the way they operate in the fisheries system and draw meaning out of such associations. The social learning, traditional knowledge, food, nutrition and employment provisions and mutual collaboration to deal with natural and human-induced challenges are seen as important factors that contribute to the value perception of dried fish value chain actors. They do not always consider the economic viability angle alone, but rather perceive fisheries as a space for self-actualization, adaptability, and sense of security. The continuity of these efforts through success and failure is what makes fisheries a 'social struggle' (Bavinck et al., 2018).

Therefore, the value in the dried fish value chain as a performance matrix of the SESDFVC implies a strong departure from typical revenue and technological upgradation perspective of a commodity value chain. The following Table (Table 4.7) provides a comparative picture of indicators that highlight the differences in value chain performance between a conventional value chain and SESDFVC.

Table 4. 7: Comparative analysis of value perceptions in conventional and SES oriented dried fish value chain

Conventional dried fish value chain	SES-oriented dried fish value chain
Value is expressed in terms of revenue gain from value stream	"Value" is beyond revenue gain both in material and non-material terms. It captures diverse ways of value creation by appreciating social-ecological realities in an integrated way. Value is expressed as income, food security, relationships, self-esteem, identities, social ties, traditional ecological knowledge and protection of fisheries resource systems.
Utilitarian view where in value is a function of individual's subjective preference	Value is a function of both individual and societal choice. Social power, confirming to social and cultural processes and recognition community values. Small-scale dried fish operators in this case study context place higher value on they are being a part of specific caste, linguistic and resource user groups.
Importance on income, employment, labour, and value	Importance of material, subjective, and ecological aspects of wellbeing

chain assets which are part of material wellbeing	
Revenue gain as designed feature determine value chain structure, conduct and performance	Social-ecological wellbeing could both be a process and outcome determinant of value chain structure, conduct and performance. It helps in finding meaning in fisheries resource as a value chain node and upper segment actors (fishers and small-scale dried fish processors as active collaborators.

In the context of SESDFVC, value is expressed as social-ecological wellbeing that appreciates discursive practices deeply embedded in traditional ecological knowledge. The framework places a higher importance on food security, intergenerational equity, place-based identity, cultural context, and institutional interactions across value chain actors and support agencies. The case examples also imply the criticality of recognizing social position to deal with vulnerabilities in discussing the value perception of upstream actors in dried fish value chains. Factors include caste, class, gender and linguistic dynamics, social life in relation to ecological systems, accessibility, product mobility and the adaption capacity. The broader connotation of value as wellbeing not only provides for robust analytical framework of understanding value chain gains, but it also has potential to reimagine policies by appreciating the non-material benefits of small-scale fisheries and more particularly the dried fish operations (Pradhan et al., 2022; Weeratunge et al., 2014). Social-ecological wellbeing as value chain performance supports a vision of community centrality and provides for holistic understanding of contextual realities by combining social, economic, environmental, cultural and political conditions (Pradhan et al., 2022; Wiseman & Brasher, 2008).

4.7. Conclusions

A social-ecological systems (SES) perspective of dried fish value chains emphasizes the dynamic interactions of material, relational, subjective, and ecological dimensions that determine “value” for the actors engaged in the value chain. The wider connotation of “value” offers a comprehensive framework to analyse value chains and their performance which is critical for decision making. Value analysed through the SEWB framework offers nuanced perspectives on life satisfaction issues like identity, equity, and adaptability to change. It also adds meaning to

value discussions with a greater focus on fishers' concerns for fish habitat, non-linear feedbacks across scales and dealing with disturbances emanating from natural and human induced factors. Dried fish value chain decisions for considerations of social-ecological wellbeing of upstream actors have the potential to break certain path dependencies wherein they play as active value chain collaborators rather than mere suppliers of inputs. Such shift in value chain conduct will ensure distributional justice which is critical to achieve the core objective of the Small-Scale Fisheries Guideline, 2014 (FAO, 2015) . Furthermore, such an approach has greater relevance in the context of complex human and environment relationships that shape life goals and life satisfaction measures of individuals over spatial and temporal scales. The analysis can be further improved with greater attention to governance of social-ecological wellbeing in the context of SESDFVC which is beyond the scope of this study. However, the analysis presented provides sufficient ground to assume that value chains without attention to the diverse ways people perceive the "value" of dried fish will continue to raise questions regarding its social and ecological appropriateness, and the promise of conventional value chain perspectives to benefit the poor.

Chapter V

Conclusions

5.1. Chapter Outline

The objective of this final chapter is to synthesize the significant theoretical and applied knowledge contributions from the study. The chapter provides an overview of the doctoral research in the context of the research gap that exists in comprehending value chains in general, and the dried fish value chain. Products such as dried fish, which are rooted in specific social, ecological, political, cultural, and geographic contexts, cannot be examined in isolation from their various ongoing social and ecological processes, dynamics, and relationships (Adger, 2006; Jentoft, 2000; Pradhan et al., 2022). An overtly financial view of fisheries value chains ignores non-capital and non-trade relationships that have a considerable impact on complex social, ecological, and institutional interactions at multiple scales (Altenburg, 2007; Ericksen, 2008; Ferguson et al., 2022; Marshall, 2015; Mitchell et al., 2009). In consideration of the above gaps in understanding fisheries and their related value chain, this research advances the scholarship on the dried fish value chain with an empirical analysis of the value chain using a social-ecological systems lens to value chain analysis.

The chapter summarizes the purpose, objective, and key findings captured in the three manuscripts (chapters two to four). The chapter also discusses the limitations of the study, future research opportunities, and reflections on the overall personal experiences of carrying out the dissertation research.

5.2. Research Purpose and Objectives

The purpose of the dissertation is to examine the dried fish value chain and expression of value from a social-ecological system perspective. There are three objectives that guided the research. The objectives are as follows:

- To map the social-ecological attributes of the dried fish value chain (feedback, linkages, uncertainty, emergence) at the production and processing nodes.
- To empirically examine how fishers and dried fish workers (upstream actors) perceive the dried fish value chain in relation to SES attributes and indicators.

- To analyze how SES-oriented value chains contribute to unpacking "value" as the social-ecological wellbeing of small-scale fishers and dried fish producers.

The first objective aimed at identifying key SES attributes and analyzing them in the context of dried fish value chains and exploring the possibility of a novel theoretical framework, i.e., a SES-oriented dried fish value chain. The second objective was to empirically examine the SES oriented dried value chain through a case study on dried fish value chain operations in Odisha and West Bengal on the coast of the Bay of Bengal. The shift in analytical perspective of the dried fish value chain from a neo-classical economic orientation to a social-ecological system orientation with upstream actors at the center of analysis calls for re-imagining of the understanding of "value" beyond financial flows across different nodes. Therefore, the third objective of the research was to understand how the upstream actors derive value from their interactions with the dried fish social-ecological system.

These objectives were examined using an interdisciplinary conceptual framework. The framework considered resource dynamics as an important and influential node in the value chain structure. The analysis across the dried value chain segment helped to identify the criticality of different chain segments and key considerations within each segment. Three critical theoretical areas contributed to framing this research: value chains, social-ecological systems, and the social and ecological wellbeing of fishers and dried fish workers. A systematic scoping review of the literature resulted in the development of a novel social-ecological system oriented dried fish value chain (SESDFVC) framework (objective 1). The second and third objectives are achieved through an empirical investigation using a multilocation case study approach in northern Odisha and the eastern West Bengal coast of the Bay of Bengal with a focus on upper segment value chain actors. The results of the first objective guided the empirical research on SESDFVC (objective 2) and painted a wider perspective of ‘value’ as the social-ecological wellbeing of fishers and dried fish processors (objective 3).

Multiple theoretical lenses and perceptions of actors operating at different value chain nodes shaped the enquiries and generated new insights about dried fish value chain. The research on SES and fisheries places higher significance on place-based human and natural system interactions. It demands researchers to find meaning from the social, historical, political, economic and ecological contexts with a clearly articulated purpose (Creswell & Creswell, 2017). Therefore, a pragmatic world view was adopted in this research, as it allowed the

researcher to be free of mental and practical constraints imposed by ‘‘forced choice dichotomy between post positivism and constructivism’’ and calls for a convergence of quantitative and qualitative methods (Creswell & Clark, 2017, p. 27; Yvonne Feilzer, 2010). It also helped in adoption of an integrated methodology recognizing both quantitative and qualitative methods. Thus, a mixed methods approach with a complementary research design was adopted and helped to combine results from systematic literature review and field studies in a coherent manner (Golicic & Davis, 2012).

The field research was conducted with a case study approach as it provides for a comprehensive, holistic, and in-depth investigation of a complex phenomenon within its context, in addition to having a stronger participants' perspective (Creswell & Creswell, 2017; Harrison et al., 2017; Merriam & Tisdell, 2015; Yin, 2014). The case study approach was useful for employing convergent mixed method approach and adopting an iterative process of data collections and interpretation to derive overall results. It also helped in conducting further probing in case of contradictions and incongruent findings with research participants (Creswell & Creswell, 2017). In case of Covid-19 and multiple research locations in Odisha and West Bengal, this approach was quite helpful as I could optimize my travel and data collection time with research participants by collecting quantitative and qualitative data simultaneously.

5.3. Major findings

Based on each of the objectives, the major findings of the dissertation study were presented in chapters 2, 3, and 4. These chapters were produced as related but independent manuscripts.

The second chapter advanced the scholarship of the dried fish value chain with a novel SES oriented dried fish value chain (SESDFVC). The conceptual framing of the SESDFVC was done through a scoping review of the literature that has direct and indirect relevance to the dried fish economy and actors engaged in the dried fish value chain, particularly in the upper segment. The scoping has been done with two objectives: 1) to understand the extended value chain characteristics of dried fish; and 2) to outline the key social-ecological attributes of the dried fish value chain that accommodate contextual reality and dynamic ecosystem-human interactions through an interdisciplinary analysis. The dried fish value chain literature is limited, and the lion's share of the literature is focused on technological aspects with regard to drying techniques and enhancing quality parameters. Therefore, strategic investigation of the targeted research

questions is made through an explicit approach to identify, select, and examine the layers of literature to empirically enhance the scope beyond dried fish literature. The paper derives critical insights from proxy literature through selective search criteria, with the central question relating to the social-ecological system dynamics and attributes of the dried fish value chain. Specific inputs and perspectives are scoped through a targeted search of literature with higher topical relevance to the dried fish system, which includes: the dried fish value chain, the small-scale fisheries (SSF) value chain, social-ecological systems and SSF, the food system value chain, and pro-poor value chain literature. The analysis is done by organizing the literature in a sequential manner. First, by outlining the main features of conventional value chains and their limitations, and in particular highlighting the importance of value chain structure, conduct, and performance. Next, through synthesizing the key features of a social-ecological systems view of value chains in a dried fish context, drawing on the main theoretical and empirical contributions from documented applied research and the relevant literature. Here, the emphasis is on feedbacks across scales, linkages (social-ecological), the role of uncertainty, and emergent properties. At the end, we compared dried fish value chain parameters through the lens of conventional and social-ecological system perspectives, and proposed a framework that better accounts for complexity in the system.

The hybrid and interdisciplinary conceptual framing of a SES-oriented dried fish value chain outlines several novel ideas in terms of its main components and cross-scale interactions. **Firstly,** the framework introduces the resource base, or the fisheries ecosystem, as a central and/or novel node in the dried fish value chain. As discussed above, the absence of resource and ecosystem considerations tends to create a lopsided value chain with a significant bias towards economic and market mechanisms. This positioning comes at the cost of excluding the fish and the fishers. The principle that 'if there is no fish (and its habitat), there is no dried fish' will become a reality if we continue to exclude the resource and ecosystem node from the value chain (Jentoft, 2000; Nayak & Berkes, 2011, 2019). The resource node is fundamentally dynamic and determines the price, product and livelihoods of resource dependent communities, and regulatory framework, which are critical to the functioning of the value chain. **Secondly,** the SES value chain perspective places the production, processing, trading, retailing, and consumer nodes from the conventional value chain along the new resource and ecosystem nodes in a two-way feedback relationship. Doing so clarifies that these nodes are bound by multiple interactions across several

scales and levels of the entire value chain—that they are in fact 'co-produced'. In tandem with the new resource and ecosystem node, the four conventional nodes help to generate a comprehensive view of the dried fish value chain and a logical sequence in which value chains tend to function effectively. **Thirdly,** the framework reflects a social-ecological system view of the dried fish value chain by organizing nonlinear feedback, dynamic linkages, uncertainties, and emergence as the key attributes that guide the node level interactions. **Fourthly,** the three segments, namely, structure, conduct, and performance, of the value chain remain integral to its core and an active part of the interactive process involving the SES attributes and the five nodes.

The dynamic interplay of SES attributes, variables, and their expressions vis-à-vis the structure, conduct, and performance indicators in the dried fish value chain offers a strong departure from the conventional value chain. The conventional value chain focuses on technological innovation in relation to time and distance, and the chain is adverse to surprises. In contrast, a SES-oriented dried fish value chain thrusts upon the wellbeing of the resource base and the actors, particularly in the upper segment of the value chain. It considers upstream actors as active collaborators, values the dynamic resource context, and provides new insights for dried fish value chain management.

The third chapter delves into the second objective of empirically examining the dried fish value chain in relation to SES attributes. The empirical data obtained from the case study site covers two villages and three markets in northern Odisha and the eastern West Bengal coast of the Bay of Bengal. The chapter offers an empirical outlook on the SESDFVC conceptual framework presented in Chapter 2. The empirical analysis presented in the chapter established SESDFC as a tool that can help analyze value chain structure, conduct, and performance with a contextual understanding of system feedbacks, linkages, uncertainties, and emergences. The nonlinear interplay of information, technology, policy, biological fluxes, customary norms, and social interactions, as well as the blurred division of actor roles, are essential elements of the Bay of Bengal dried fish value chain (Belton et al., 2018; Pradhan et al., 2022). It is evident that the resource system is crucial and has a great influence on the DFVC's production, market, and labor dynamics (Belton et al., 2018; Pradhan et al., 2022). Moreover, the significance of the resource system is high, as 69% of the respondents have mixed identities as fishers, dried fish processors, and in some cases, local aggregators. There is a positive correlation between fish production and dried fish output by small scale operators, as well as their power in the market in terms of price,

access to other markets, and credit mechanisms. The attribute level analysis maps the social, economic, and ecological interactions, multiple non-linear feedback loops among actors and value chain nodes, offering a comprehensive understanding of place-based and actor-based issues in a disaggregated manner. This has significant implications for analyzing the issues and structural barriers with upper end value chain actors, as well as enabling them to participate in the value chain decision making process. Scholars working on pro-poor value chains consider the power of the poor in the market and their active participation in the value chain as the most critical aspects of the value chain functioning.

The dried fish value chain in the case study location has been experiencing non-linear feedback from within and outside of the fisheries sectors. The feedback loops are shaped by system intensification, diversification, and change in societal interactions with spatial, temporal, and scale dimensions. Intensification in production, technology, and gear at the bio-physical resource node has resulted in the competition for space, changing habitat characteristics, and low catch per unit effort by small scale fishers. In addition, it has also resulted in a material cost increase, greater mobility of fish, and blurred geographic division in procurement of desired dried fish species. It is causing multiple feedbacks in dried fish production, processing, and marketing nodes. Similarly, diversification and change in societal interactions are manifested through increasing labor mobility within and outside of the fisheries sector as well as deeper understanding of place-based factors such as the lunar cycle.

The analysis of linkages with regard to rules, resources, roles, and responsibilities established a dynamic pattern of interactions among value chain actors. The mixed identities of the actors in the dried fish value chain and the fuzzy boundaries across the nodes make the interactions and linkages in the value chain dynamic and evolve with time and space. While conventional value chains fail to appreciate the dynamic linkages and tend to promote adjusted vertical integration, the SESDFVC embraces the complexities of value chain linkages by reimagining value chain connections and performance through the prism of the social-ecological wellbeing of value chain actors. Furthermore, SESDFVC analysis provides for a greater discussion on justice, in terms of access and interactions with both the ecosystem, and affected human communities, from a multi-scalar perspective. The study region is exposed to a high level of uncertainty associated with natural hazards, market, and policy processes. Conventional value chain processes consider engaging with uncertainties through a risk minimization framework governed by organizational

and supply chain efficiency logic (Pradhan et al., 2022; Simangunsong et al., 2012). In contrast, the SESDFVC recognizes uncertainty as a critical attribute that which makes the system adaptive to constant change. Competitive advantage is seized by being culturally, ecologically, and socially relevant.

The effective mapping of feedbacks, linkages, uncertainties, and emergences within and across value chain nodes has greater implications for removing trade barriers in terms of infrastructure for dried fish processing, access to fair credit systems, uptake of welfare schemes, transparency in trade transactions, greater buyer-seller interface, structured price discovery mechanisms, and gender and caste-based inequalities (Adger, 2006).

In Chapter Four, I advanced the scholarship on value chains by unpacking the "value" connotations beyond its conventional neo-classical understanding as financial return and revenue multiplication across the node. The use of the SESDFVC framework provided an empirical outlook on how the dried fish value chain contributes to a process of visualizing value as social-ecological wellbeing. The social-ecological wellbeing as a performance matrix helps the upstream value chain actors examine the broader conception of benefits, they derive from being a part of the human-environment system. In the context of SESDFVC, value is viewed as social-ecological wellbeing that appreciates discursive practices profoundly grounded in traditional ecological knowledge. It places higher importance on food security, intergenerational equity, place-based identity, cultural context, and institutional interactions with various stakeholders. The case examples also demonstrate the importance of recognizing social position, such as caste, class, gender, and linguistic dynamics; social life in relation to ecological systems, accessibility, product mobility, and the adaptive capacity to deal with vulnerabilities while discussing the value perception of upstream actors in the dried fish value chain. The larger meaning of value as well-being not only gives an analytical framework for analyzing value chain gains, but it also has the ability to reinvent policy by recognizing the non-material benefits of small-scale fisheries, particularly dried fish enterprises (Pradhan et al., 2022; Weeratunge et al., 2014). The value chain performance of social-ecological wellbeing encompasses the notion of community centrality and gives a comprehensive knowledge of contextual realities by combining social, economic, environmental, cultural, and political variables (Johnson, 2017; Pradhan et al., 2022; Wiseman & Brasher, 2008).

The results presented in chapters two to four advance the scholarship on value chains in general and the dried fish value chain in particular by developing a novel analytical framework. The framework provides for novel outlooks on structure, conduct, and performance that have greater alignment with the inclusive pro-poor value chain approach. The departure of thinking from profit and market logic to system logic that involves social, economic, and ecological interactions provides a comprehensive understanding of place based and actor-based issues in a disaggregated manner. It is responsive to local conditions and provides equal access to natural resources, rights, responsibilities, and cost-effective technologies for efficient usage (Ros-Tonen et al., 2015). SESDFVC, with a focus on building understanding of non-linear feedback, dynamic linkages, uncertainties, and emergences as system attributes, is better placed to address the concern of breaking trade barriers for the poor to participate in the value chain as key contributors. SESDFVC provides a comprehensive understanding of the relevant questions in the value chain analysis, such as "who owns what?" "who does what?" "who gets what?" and "what do they do with it?" Further, by reimagining "value" as social-ecological wellbeing, SESDFVC brings exclusive attention to the question of how they experience the value chain interactions (Belton et al.,). Table 5.1 illustrates the departure points in SESDFVC in relation to the conventional dried fish value chain. SESDFVC shifts the narrative to understand the value chain structure, conduct, and performance by appreciating the social-ecological connection between the value chain actors and the dynamism in fisheries resource system. The SESDFVC, therefore, places a higher importance on material, relational, subjective, and ecological wellbeing concerns over a narrow financial value framework.

Table 5. 1: Key shifts in SES oriented dried fish value chain dynamics from conventional value chain

Value chain aspects	Conventional dried fish value chain (VC)	Novel SES-oriented dried fish value chain
Structure	Biophysical resource base is exogenous to value stream and the problem in the resource is treated as externality.	Biophysical resource is critical and internal to value stream in the value chain and considered as an important node in the value chain structure
	Focuses on linear feedback among value chain nodes and actors across value stream in a vertical manner	Places importance on non-linear feedbacks and interaction across the level and scale is dynamic. Horizontal issues are given equal

		importance.
	Fisher and dried fish workers as passive contributor of input and labour and the weakest economic agent with regard to value chain decision making	Fishers and dried fish workers as active collaborators with contextual knowledge and cultural bound norms. Participatory and gender aspects are critical for VC decision making
Conduct	Market logic (profit)	System logic (social, economic, and ecological)
	Weak connections and interactions between social justice, social wellbeing, and environmental justice	Greater consideration of resource and human connections and subsystem interactions. Equal importance on upstream issues (resource system, fisher, and dried fish workers), identity, food security alongside profit and revenue gain.
	Value Chain efficiency is seen as the aggregate value creation across node. Techno-managerial changes are determined through profit points irrespective of value chain segments	Performance is critical within and among subsystem of value chain (nodes and segments). Upstream (resource and fishers) aspects are critical for SES oriented dried fish value chain.
Performance	Revenue gain as designed feature determine value chain performance. Utilitarian view where in value is a function of individual's subjective preference.	Social-ecological wellbeing could both be a process and outcome determinant of value chain performance. "Value" is beyond revenue gain both in material and non-material terms. The value is seen as social capital, social power, influence, public image, belongingness, confirming to social and cultural processes and recognizing community values.

5.3.1. Theoretical and methodological contributions

The research has advanced the scholarship on small scale fisheries value chains and, more specifically, dried fish value chains with a novel theoretical framework called "social-ecological system oriented dried fish value chain analysis".

In general, the research offers a strong case for reimagining a pro-poor value chain approach for the fisheries sector, particularly the dried-fish subsector. The research further establishes the

criticality of bio-physical resources as a crucial value chain node rather than a mere enabler for value chain inbound logistics. Resource being a critical node redefines the structure, conduct, and performance framework of the dried fish value chain. It makes a compelling case for analyzing the dried fish value chain using social-ecological system attributes that appreciate both capital and non-capital relationships.

Such a shift in theoretical understanding elevates the position of upstream actors from passive contributors to active value chain actors. This is because the interactions between resource and value chain actors are explicitly captured and the value chain performance framework is visualized as a wider meaning of "value" in the value chain.

The doctoral research also offers a methodological framework to undertake hybrid analysis by combining multiple theoretical approaches involving social-ecological systems, small scale fisheries value chains, and social-ecological wellbeing. More precisely, the novel SESDFVC places importance on the resource dynamics and relationships with the upstream value chain actors. Critical features of equity and wellbeing for poor fishers, small-scale dried fish processors, and workers across the value chain are also not usually recorded, especially when they are closely tied to the ecological foundations of the value chains.

Comparatively, an SES perspective on value chains invites examination of different realities as well as linked understandings of the social, cultural, and economic repercussions across time and location. Furthermore, a SES-oriented value chain as a theoretical lens views the bio-physical resource to be a significant node, and the upper segment players (fishers and dried fish workers) to be active collaborators rather than passive contributors to the dried fish value chain. SES-oriented value chain analysis also adds to the study on pro-poor value chains, where the role of the primary producer and equitable benefit allocation in favor of upstream players are crucial.

The SESDFVC offers a comprehensive perspective on a robust economic process that rests on a co-evolutionary approach to interdependencies between ecological sustainability, technological development, innovation, market institutions, and resource geography (Truffer & Coenen, 2012). These interdependencies are still missing in sectoral planning for dried fish products.

5.3.2. Applied and policy contributions to sustainability discourse and beneficiaries

The case-specific empirical contributions of this dissertation are highlighted in chapters III and IV The case study on the eastern coast of the Bay of Bengal involved two research locations in

northern Odisha and southern West Bengal. This is an excellent illustration of the varied social, cultural, economic, and ecological actors involved in the dried fish value chain. According to the research findings, contextual social and ecological factors play a significant role in determining the value chain for dried fish, which is distinguished by the dispersed production system and the predominance of self-employed firms in research sites. By applying the SES lens, we have argued that fisheries form one important node in the value chain of dried fish which is implicit in the value chain structure. The empirical analysis undertaken in the thesis research aids in the analysis of small-scale fisheries and dried value chain structure, conduct, and performance by appreciating both capital and non-capital relationships nuanced with place-based understanding. This makes dried fish value chains distinct and supports their analysis from a SES perspective. The renewed understanding of the dried fish value chain has the potential to bring about appropriate policy decisions for sustainable value chain operation and protection in the interests of fishers and dried fish workers who are at the extractive end of the value chain. Simultaneously, the SES oriented dried fish value chain understanding has greater relevance for fostering community stewardship and facilitating the attainment of sustainability standards and certifications such as MSC (Marine Stewardship Council) or ASC (Aquaculture Stewardship Council). This type of certification can create self-reinforcing feedback loops by promoting fair trade practices that employ socially, economically, and ecologically responsible methods in fish harvest and dried fish processing.

The iterative process adopted for the research helped in co-evolving the research questions and objectives by conducting reconnaissance surveys in the study location. The approach also helped communities involved in dried fish operations to analyze the social-ecological attributes of the dried fish value chain with the researcher and identify critical gaps. These gaps include policy, programmatic, and institutional arenas concerning resource systems, catch management, dried fish production, aggregation, and marketing. Instances are found where self-employed dried fish units are linked to credit sources like self-help federations and enterprise development incubation through the small village enterprise development programme of the Indian government. Three women's collectives from the study areas have approached the government for assistance in establishing dried fish processing business units that meet phytosanitary standards. The insights of an SES-oriented dried fish value chain add new meaning to the value of the dried fish as a "commodity" in the value chain that is derived through its relationship with the people and

environment in which it is produced (Johnson, 2017; Thompson & Open University, 1991). Such an understanding has the potential to influence the development of livelihoods strategies for the poor in general and fishers and dried fish processors. The government of Odisha has started piloting the inclusion of dried fish-based products (viz., small fish powder and dried small fish) in the supplementary nutrition programme under the integrated child development scheme (Goo, 2022). The government procurement of dried fish as a nutrition product provides for a conducive policy and market support for small scale dried fish processors. It removes trade barriers for them to participate in the value chain. In addition, the empirical case study and the dried fish analysis with a social-ecological systems view have the potential to enrich cross-country learning on the subject. It contributes to the global research and learning exchange initiatives under the Dried Fish Matters research partnership, involving six South and Southeast Asian countries. The study also has greater alignment with and input into vulnerability to viability global research partnerships in 12 Asian and African countries.

Besides contributing towards an inclusive value chain approach and placing the fishers' and dried fish worker's perspective in value chain planning and decision making, the research also provides a stronger narrative for the complex web of interactions among various SDGs. This includes SDG 14.b. Target 14.b, which aims to provide access for small-scale artisanal fishers to marine resources and markets. Small-scale artisanal fisheries are a dynamic and evolving labor-intensive sector encompassing all activities along the value chain – pre-harvest, harvest, and post-harvest to exploit marine and inland water fishery resources (Blanc et al., 2018). The analysis done by Blanc et al. (2018) suggests an interesting pathway of SDGs that can either influence or be influenced by the achievement of SDG 14.b. This analysis further connects with the broader UN interaction framework identified in the 32nd meeting of committees on fisheries, 2016 (UN, 2018). The indicator level analysis depicts a stronger interaction of 14.b with the host of SDGs like SDG 1, 2, 4,5, 10, and 17(Nayak et al., 2021). The research also provides impetus and a new dimension to the small-scale fisheries guidelines (SSF guidelines), which are one of the key references for policy making across the globe. SSF guidelines and the countries ratified the same have taken a broader view towards fisheries legal and management instruments with integration of social and ecological concerns. The guidelines shifts the narrative towards both sustainability of fisheries resources and the wellbeing of people involved in it (FAO, 2015). The explicit reference to ecosystem approach to fisheries (EAF) provides for a governance pathway

that places higher importance to participatory and decentralized approaches. The SESDFVC with primacy on social-ecological wellbeing of upstream value chain actors and biophysical resource as a critical node will contribute to better implementation of SSF guidelines as a global policy instrument.

5.4. Limitations and future research directions

The dissertation work was challenged by the limited literature on dried fish value chains and dried fish social-ecological systems. The global literature review suggests that the literature on dried fish is dominated by analysis from food sciences. At the same time, topics such as ecology, culture, social relations, policy, and governance that are important for a holistic understanding of the dried fish sector received less attention in the academic literature (Belton et al., 2022). Considering the paucity of relevant dried fish literature, insights were drawn from the small-scale fisheries value chain, social-ecological systems, and wellbeing in the SSF context to build the conceptual framework. The social-ecological system understanding of the dried fish value chain places importance on place-based attributes that are diverse, relational, and internally varied (Johnson, 2017; Pradhan et al., 2022).

The research provides for having a broader dried fish value chain framework that appreciates non-capital relationships and the ecological integrity of dried fish systems. However, additional case studies on the social-ecological system oriented dried fish value chain will contribute to the empirical breadth of the SESDFVC approach and bring comparative analysis to strengthen its practical outlook. The dissertation provides empirical ground for identifying and analysing attributes of the dried fish value chain through an SES lens and assessing the value chain performance from the standpoint of the social-ecological wellbeing of upstream actors. The analysis presented provides sufficient foundation to assume that value chains, without attention to the diverse ways people perceive the "value" of dried fish, will continue to raise questions about their social and ecological appropriateness and their promise to benefit the poor through their participation. However, future research on the governance of SESDFVC and its implications for supporting macro processes such as sustainable development pathways and achieving Code of Conduct for Responsible Fisheries (CCRF) compliance will aid the scholarship on dried fish social-ecological systems.

At an operational level, the COVID-19 pandemic has posed several roadblocks in pursuing the field research as per the research design, plan, and timeframe. Covid-19 demanded specific

ethics protocol as per the government of Canadian and Indian government regulations. The COVID ethics clearance process took a long time, and hence it delayed the start of the research. Delays also caused missing out on key seasonal fishing activities in the study location. Secondly, due to COVID-19 constraints and difficulties in inter-state travel within India, the study sites were reorganised. The case study sites were strategically decided within the jurisdiction of one state but have strong interaction in both Odisha and West Bengal in terms of dried fish operations. Though it was a deviation from the original design of having two sites from two states, the new sites provided new opportunities in terms of understanding the dried fish operations with different social-ecological characteristics. Both sites have strong value chain connections and interactions on the eastern Indian coast of the Bay of Bengal, which elevated the research scope from West Bengal to the eastern Indian coast of the Bay of Bengal.

Further, as per the COVID ethics protocol, the methods that involved interactions in a group setting were avoided. The plan for focus group discussions and community meetings as key tools for data collection was shelved. However, being in the case study location helped me to adapt and customize field arrangements to coincide with growing pandemic risk levels and changing local health legislation. Data collection methods were restricted to household surveys and semi-structured interviews. However, my presence on-site also helped to identify and hire research assistants from the local communities that were knowledgeable of the local circumstances. I constantly mentored them and conducted household surveys and interviews as per the demand of the situations. The dried fish value chain in the research region is characterized by diverse fishing, processing, and marketing techniques, as well as multi-scalar interactions of value chain players across a vast geographical range that includes Odisha, West Bengal, the North-eastern states, and bordering countries. Because of mobility constraints, respondents from various nodes were chosen and interviewed using a flexible adaptive approach based on the COVID situation at their workplace. This leaves future research scope to advance a fuller understanding of the entire dried fish value chain by incorporating insights from varied place based operational practices and chain actors in the larger product geography.

5.5. Personal reflections

Working with the "Dried Fish Matters" (DFM) research partnership and V2V global partnerships, especially in India, contributed to my learning and overall doctoral research experience. These platforms, along with Too Big to Ignore (TBTI), offered numerous

opportunities for discussion of findings and cross-pollination of ideas. These activities significantly contributed to shaping my research methods and improving academic rigor and practical relevance.

At a personal level, undertaking the thesis research during the pandemic was at times overwhelming. At the same time, it is quite a humbling experience to spend time at the study locations at a time when fishers and small-scale dried fish operators were coping with uncertainties from the pandemic and the aftermath of cyclones Fanni and Yash. With COVID 19 restrictions in place, the delay in research ethics approval, and missing out on the seasonality of the dried fish process were quite challenging,. However, observing the tenacity of the fishers and self-employed dried fish enterprises against all odds was quite inspiring. There is limited time availability for field work and restrictions on employing research methods that involve interactions in a group setting. It raised initial concerns as methods like focus group discussions and community meetings are suitable for investigating complex behaviors and motivations with varied viewpoints of participants, particularly fishers and dried fish workers (Cameron, 2005; D. Morgan & Krueger, 1993). This limitation was reduced by my local connections, my association with local NGOs, government officers, and a large network of women's self-help groups. Such relationships helped in identifying research assistants from the local areas and obtaining honest opinions and responses from the value chain actors. The small-scale dried fish operators, specifically fishers and dried fish processors, found meaning in sharing the genuine feedback as they felt safe and were appreciative of the fact that their work is getting public attention. However, the traders and wholesalers were initially hesitant to share data and information as they feared that the research might influence the informality of trade that is exempted from goods and services tax. The hiring of local research assistants and their presence in the field location have contributed to building relationships and reducing threat perceptions among the traders and dried fish processors. The approach taken to engage with the dried fish community has also been marked by the co-creation of knowledge and the leverage of relationships to place the issues and community enquiries in an appropriate forum for local action. As a result, the researchers had a supportive rather than a dispassionate role in the research all while limiting any personal bias that may have shaped the insights of the research.

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Appendix A

Village Survey Guide

General Questions

a) Code------

b) Gender

1. Male
2. Female
3. Transgender
4. Other

c) Age (In Years):

1. >18 Years
2. 18-30 years
3. 30-50 Years
4. <50 Years

d) Highest level of education completed:

1. >8th
2. 8-10th
3. 10-12
4. Graduate and above

e) Place of origin (If different from interview location, when/why moved here):

f) Family details:

1. Married [ ]
2. Unmarried [ ]
3. Children [ ]

g) Role of interviewee

1. Fishers
2. Boat owner
3. Worker
4. Trader
5. Retailers

h) Name of the village/ Market/Drying unit:

I. Node 1: Fisher's/ producer's segment

a) Settlement type

1. Permanent [since…..]
2. Temporary [since…..]

b) If permanent settlement

1. How many households live in this village? :……
2. How many households were there in the village 5/10 years ago? :……
3. How many households own agricultural land?
:……

c) If a temporary settlement
1. During which months do fishers settle here? :……
2. How many boat owners operate here?
:……
3. How many boats were there? 5/10 years ago?
:……
4. How many men/women workers are there here? 5/10 years ago? :……
5. Where do boat owners come from? :……
6. Where do their workers come from? :……

d) What are the main types of fishing vessels and gears used in this area; When were these first introduced? Where from?

e) What are the main fish species caught in these gears; Which among these are the main species dried? Why dried/fermented, not sold fresh?

f) How many households in the village/settlement own fishing boats?
- How many owned fishing boats 5/10 years ago? :……
- How many boats are there in total? :……
- How many boats were there 5/10 years ago? :……
- Why has the number of boats has changed? :……
- Has the size of boats and gears changed (Y/N) :……
  If Yes, Why/how? :……

g) What is the ethnicity and place of origin of groups that are involved in fishing and associated activities? :……

h) Are there any boat owners or boat captains associations here (Y/N)? :……
If Yes, How many people are members? :……

i) Is ice widely available here (Y/N)?

:……

- When did this happen?
- Has this affected the proportion of fish sold fresh vs processed (give detail)
- When did fishing boats become mechanized here? :……
- How did this affect fishing methods, effort, landings?

:……

j) How much fish do you catch every day (everyday) in peak time and lean period?

k) What is the peak time of catch according to you. What is the reason for that?

l) What is the trend of fish catch over last ten years?

m) What are different type of species you catch and out of which what are the different varieties that go for drying.

n) Why such species are preferred for processing?

o) Where do you sell your fish? (on the landing site, processing units nearby, in the local market, any other)

p) What is the mode of sell (auction, through middle man, direct sale to buyers, others..)

Node 2: Processing

Node 2.1: Processors:

a) What is the name of this location? :……

b) When did fish drying first begin here?

:……

c) How many fish processing businesses are there located at this location now? :……

- How many were there 5 years ago? :……
- 10 years ago? :……
- Where do the owners of these businesses originate from? :……

d) How many of the fish processors here also own their own fishing boats?

- What is the ethnicity and place of origin of groups that are involved in fish processing and associated activities?

e) How many households here have members who work as processing labor for other households?
    - How many households are involved in fishing?
    - How many households trade fish?
    - How many households have members who work in fish processing?

f) How many workers you hire for fish processing activities?
    - How many of these are M/F? Male:……. Female:…….
    - How about 5/10 years ago?

g) What are the main species processed by you?

h) What are the main processed products produced by yoy?
    - How has this composition changed in the past 5/10 years?

i) Are there a fish processors association here?
    - Are you a member?
    - How many members are there
    - What is the purpose of this association?
    - Are there any rules enforced by the association?
    - Who leads the association?

j) Is there any cirtification system exists (yes/No)
    If yes, who cirtify and what is the mechanism?

Node 2.2: Dried fish Workers

a) How many co-workers are there doing work related to dried fish?

b) Where do you come from?

c) During which months/seasons do they do this work?

d) What is the average daily or monthly wage or income earned by you doing the most common type of work here (specify the type of work)?
    - What was the average 2 years ago?
    - What was the average 5 years ago?

e) How many workers were there in this location doing work related to dried fish 5 years ago? If the number has changed since then, why?

f) What is the percentage of men/women/children in the labor force?

- What kinds of work do they each do?

g) Are there any workers associations or unions in your locality?

- How many?
- Which are they?

h) What are the workers unions associations based on?

1. Political parties
2. Castes
3. Religion
4. Ethnicity

i) Are there any unionized labor laws or are there any norms when it comes to work?

j) Do the dried fish workers also work in other sectors (Y/N) :……

- If Yes,

1. Agriculture labour
2. construction worker
3. Daily Worker (in other sectors)
   - During which months/seasons do they do this work?

k) Are there any health hazards associated with work related to dried fish in this location?

Interview Guide for Fishers

Segment 1

- Code:…….Age:…….Gender ……
- Highest level of education completed:…….
- Place of origin. If different from interview location, when/why moved here
- Marital Status:……..
- Family details: Married: Unmarried: No of Children: Dependent Parents :
- Do you involve only in fishing ? (Y/N), If No,
  1. Processing
  2. Retailing
  3. Worker
  4. Other

Segment 2:

- Details of fishing assets (if owned)

No of Boats Owned	Size of Boat (Length, Horsepower)	When each acquired	Cost	Source of Capital	Types of Gears fished	Number of gears owned	Cost of gears owned

- When did you begin fishing?
  - What was your occupation prior to this?
  - Do you have any fishing related businesses (e.g. processing, trading) – provide details. In which order were they established?
- Do you own any other source of Income.

- Agriculture
- Business
- Wage Labour
- Fish Workers
- Other

- Do you or members of your household do any work other than fishing? When, why? Give details.
- Do members of your family join you in fishing?
  - Which members?
  - How often?
  - Are other relatives involved in fishing?
  - How many?
  - What do they do?
- What are the main costs associated with fishing (fuel, ice, food for crew, repairs, etc) – how much is spent each of the inputs, per trip or per season?
- If you are a boat owner, In the past 12 months did you make use of any source of credit for fishing? What was the source/s? what were the terms (e.g. rate of interest, duration, commitment to sell fish to lender); what was the loan/s purpose?
- Do the natural events impact in catch and fishing activities. What is the trend in occurrence of such natural events?
- Are there any external customized support for loss and damage of assets, produce or catch due to natural hazards?
- What are the 5 main species/types of fish that you catch (ranked). Which fishing gears are used to catch them? Where are the fishing grounds?

Species	Fishing Gears used	Fishing Grounds	Peak Month	Lean Month	Amount of Fish landed in last year

- How much fish is landed on average in high/low months/weeks? 5 years ago? 10 years ago? If changed, why?
- How long are your fishing trips on average?
- How long do you spend on shore between trips ?
- How many fishers work on your boat/s: are they women/men/children/relatives? Is the boat owner also captain the boat? What are the workers'/crew members' roles?
- Are they hired long-term or on a casual basis?
- What is the prevailing wage rate and conditions of a boat worker who is involved in fishing?
- What happens to a worker if they get sick or are injured while on the boat?
- Are you availed any social security schemes? If yes, specify
- Are you member of any association? If there are disputes between members how are they usually resolved?
- How much sold for use in processing? How much did you process yourself? If you process fish, why do you do this? If you don't process fish, why not?
- What determined whether the fish you landed was marketed fresh or used for processing (e.g. species, size, freshness)?
- Where did you sale the fresh fish? Where did you sale the processed fish? Who was it sold to? (e.g. traders in this village, traders in urban wholesale market, local retailers, etc – if a mix give proportions). Do you usually sell to a single buyer or to multiple different buyers? Why?
- How are sales organized (e.g. at auction, price set in advance by buyer, by negotiation with several buyers).
- Did you take an advance from any buyer who you sell? If advance is taken, what is the prevalent terms and extent of advance in your area (amount, timing, interest, repayment schedule, whether prevents selling to others, whether sales price discounted) ?

- What was the price per unit of each of the 5 main types of fish landed, for fish of average size and quality, during peak season? What was the average price during peak season 3 years ago/5 years ago?

Segment 3:

- If there are disputes with processors or traders, how are these usually solved? Is it possible to narrate some examples of such disputes?
- How did you come to this profession?
- What are the key skills necessary to doing this job well?
- How did you learn these skills?
- Which aspects of your work do you like? Which aspects do you dislike?
- Why you are in this profession despite issues and challenges (if any)
- What is the most significant change that has occurred in your fishing during past 10 years? (positive and negative)?
- Has demand for dried fish changed within the past 10 years? How? What do you think are the reasons for these changes?
- What do you think the prospects are for the production of fish for dried fish over the next 10 years?
- Are there any community practices and mechanism that either facilitate or restricts your work?
- Are there any cultural and social norms that regulates the fishing and processing activities of different species?
- What are the biggest challenges that you face as a fisher?
- How do you cope with such challenges?
- Is there any new way of working? If yes what are those and how you have adopted them?
- Do you consider your livelihood to be risky? Why/Why not?
- Is this a choice of employment that you would recommend to others? Why/why not?
- How do you think people in society generally perceive your profession?
- Would you be happy for your children to carry on this profession?
- Do you consume dried fish? Why/why not? Which species do you prefer and why?

- Have you ever received any received any support or help from government, NGOs or any other organization (give details)?
- Are there any government regulations, policies, or activities that restrict or cause difficulties for your business (give details)?

Date:

Place:

Processors segment interview guide

Section 1:

Interview location:

Code: Gender: Age:

Highest level of education completed:

Place of origin. If different from interview location, when/why moved here

Family details: (married/unmarried, Children)

Section 2:

k) What is the name of this location? When did fish drying first begin here?

l) How many fish processing businesses are there located at this location now? How many were in 10 years ago? Where do the owners of these businesses originate from?

m) How many of the fish processors here also own their own fishing boats?

n) How many households here have members who work as processing labor for other households? How many households are involved in fishing? How many households trade fish? How many households have members who work in fish processing?

o) What are the main species processed here?

p) What are the main processed products produced here? How has this composition changed in the past 5/10 years?

- Are there a fish processors association here? How many people are members? What is the purpose of this association? Are there any rules enforced by the association? Who leads the association?
- Is ice widely available here? When did this happen? Has this affected the proportion of fish sold fresh vs processed (give detail)

Section 3:

- How large is the fish drying area operated by this business? Is the land on rent where this business is located?
- What drying equipment do you own (e.g. drying racks, frames, mats, nets)? How much do these items cost? How often do they need to be replaced?

- When did you begin fish processing? What was your occupation prior to this? Do you have any fishing related businesses (e.g. fishing, trading) – provide details. In which order were they established?
- Do you own any agricultural land; how much? Do you or members of your household do any work other than fish processing? When, why? Give details.
- Do members of your family join you in operating the fish processing business? Which members? Are other relatives involved in fish processing? How many? What do they do?
- Is ice widely available here? When did this happen? Has this affected the proportion of fish sold fresh vs processed (give detail)
- During which months does this business operate? Which are peak/low months?
- What are the different procurement practices you follow (e.g. own fishing, buy from fishers, buy from traders, terms of procurement etc). If a mix of sources, give proportions. What are the main locations that you source each of these species/products from?
- Is the supply of fish for processing fairly constant during the month, or does it fluctuate with the lunar cycle?
- What are the five main species/types of fish processed. What is the scenario before 10 years?
- How much of each of the 5 main products/species do you procure on average in one month during high season, and during low season? How about 5, 10 years ago? Why has this changed?
- How is the price for any fresh fish that you purchase set (e.g. at auction, negotiation in market or with boat owner, by advance contract). When is fresh fish usually paid for (e.g., immediately in cash, after sale of dried product)
- What was average price of the main types of fresh fish you used during the past month? What was the average price 3 years ago/5 years ago?
- Besides fish, what other raw materials do you use (e.g. salt, wood, rice bran, chemicals)? Where do you procure these from?
- How do you usually access from these species/products (e.g. catch, buy at auction, make agreement over phone, advance contract)?

- For each of the main types of fish processed, please describe in detail all the steps in processing – how fish is prepared prior to drying/fermenting etc. What happens during and after processing? Who performs each of these tasks? How long does each of the steps take?
- Is any pesticide used at any point during processing? Why/why not?
- How many workers work in your processing operation? Are they women/men/children? What are the worker's roles? Are they hired long-term or on a casual basis?
- What is the prevailing wage rate for workers. Is it the same or different for different category of workers? If yes, please explain?
- What happens if a worker gets sick or are injured while at work?
- What do you think are the qualities of good worker?
- Are you a member of a processor's association?
- If there are disputes between a processor and their workers how are they usually resolved?
- What do you do in case of fluctuations in fish procurement?
- How do you cope with extreme weather conditions? If you have experienced any, please explain?

Section 4:

- What are the practices of selling (e.g. where do you sale? when it is sold, is it always sold to same buyer or many different buyers; different products to different buyers)?
- Is it a prevalent practice to sell to any buyer. If yes, what are the main reasons (e.g. advance; good relationship/trust; relative; nearby; service etc)? If advance is taken, what is the prevalent terms and extent of advance in your area (amount, timing, interest, repayment schedule, whether prevents selling to others, whether sales price discounted) ?
- How do you usually organize sales to customers (e.g. sell at auction, make agreement over phone, advance contract)?
- How many regular customers do you have? How about 5, 10 years ago? Why has this changed?

- Do you receive payment at the time you sell your fish, or do you have to wait for part or all of the payment? Why and for how long do you usually have to wait? How do you receive the payment (e.g. in cash, by bank transfer, by cheque)
- What was the average price per unit of the main products (of average quality/size) that you sold during last peak season? What about 3 years ago, 5 years ago?
- What product grades are their (e.g. size, colour, quality)
- How do you transport the product to market? Has this changed in past 5/10 years?
- Did you choose this profession? If so, why?
- How did you enter into the profession?
- What are the key skills necessary to doing this job well?
- How did you learn these skills?
- How do you connect to fisheries and resource systems? Is it only procurement relationships or any other interactions? Please explain?
- Which aspects of your work do you like? Which aspects do you dislike?
- What are the most significant changes that have affected your business during past 10 years (positive and negative)?
- How has consumer demand for dried fish changed within the past 10 years? How? What do you think are the reasons for these changes?
- What do you think the prospects are for your businesses over the next 10 years?
- What are the biggest challenges that you face when doing business?
- Do you consider your livelihood to be risky? Why/Why not?
- Are there any new developments with regard to technology, regulatory standards? If yes, what are they and how it influences your business?
- Is there any evidence of portfolio expansion (fish for human consumption, animal feed and fish meal). If yes, why and how it helps in expanding your business?
- What kind of impact it is creating with the demands for animal feed and fish meal on fishers and resource system?
- Is this a choice of employment that you would recommend to others? Why/why not?
- How do you think people in society generally perceive your profession?
- Would you be happy for your children to carry on this profession?

- Do you consume dried fish? Why/why not? Which species do you prefer and why?
- Have you ever received any received any support or help from government, NGOs or any other organization (give details)?
- Are there any government regulations, policies, or activities that restrict or cause difficulties for your business (give details)?

Wholesale and trader market segment interview guide

Section 1

- Interviewee Code: Age: Gender:
- Role of interviewee (boat owner, worker, trader, retailers etc):
- Interview Location: Name of the Market Address:
- Market Location: Market size: Market Age/year:
- Market opening hours:
- Are there any days during the week when trade is particularly high or low?
- Are there any months during the year when trade is particularly high or low? Which months? Why are these peak or low months?
- Who owns and manages the market? Do they have an office in the market?
- Do the market authorities keep records of the quantities of fish traded?
- Is there a trader's association/s in this market?
- What is the purpose of the association? What are its activities?
- Is membership compulsory for traders in this market? How many members does the associations/have?
- What are the association rules? Who leads the association?
- How many traders are there in this market now?

Time	Male	Female	Total
Present			
Past (5-10 Years)			

- Which types of trader operate in the market(Mention number)
  1. Brokers [ ]
  2. Wholesalers[ ]
  3. Auctioneers[ ]
  4. Registered[ ]
  5. Unregistered[ ]

- Are there any traders operating informally at the edges/outside of the market? How many?
- Which places do most traders in this market originate from? What is the ethnicity/religion of traders in this market?
- How many other dried fish wholesale markets are there in this country? Where are they located? Please rank them in order of size
- What are the five most important types of product traded in this market? What share of total trade in the market dos each ofthese account for? How about 5, 10 years ago?
- Do some of the traders specialize in particular types of species/product? How many traders specialize in each kind of product/species?
- What are the main types of vehicle that transport dried fish to and from this market?
- What are the main sizes of vehicle (e.g. 6 wheel truck, 12 wheel truck?)
- How much dried/fermented product can be carried by each vehicle?
- How many of each size of vehicle visit the market each day during peak/low season? How about 5 and 10 years ago?
- How has the supply and composition of fish traded through this market changed within the past 10 years? What do you think are the reasons for these changes?
- How has consumer demand for fish traded through this market changed within the past 10 years? What do you think are the reasons for these changes?
- What sort of challenges do traders in this market face? Are there government policies or actions that benefit or hinder the dried fish trade?

Section 2:

- When did you establish this dried fish trading business? What did you do before that? Why did you decide to start this business? Where did you get capital needed to set up this business?
- Is the business a family firm? If so, in what capacity are family members involved in the firm?
- Did/does any other family member have a similar trading business or business related to fishing?
- Do you have any other businesses related to fishing (e.g. own boats, drying operations, retail shops). If so, in what order did you establish them and why?
- Do you have any businesses unrelated to fishing? What are they?

- Do you have any occupation other than dried fish business

Section 3:

- During which months does this business operate? Which are peak/low months?
- What are the five most important species/products that you trade?
- What % for your total business does each of these account for? How about 10 years ago? Why has this changed?
- How do the volumes of fish purchased vary by season? Which months are high/low season?
- How much of each of the 5 main products/species do you procure on average in one month during high season, and during low season? How about 5, 10 years ago? Why has this changed?
- What are the main locations that you source each of these species/products from?
- Is there in change in locational dimensions of source over these years.
- Is any of the fish you buy imported from abroad? Give details
- What type of suppliers do you usually procure these from (e.g. traders in this market, fish driers etc)?
- How many regular suppliers do you have? How about 5, 10 years ago? Why has this changed?
- What is the practice of procurement (e.g. buy at auction, make agreement over phone, advance contract)?
- Is it a common practice to provide credit to suppliers by wholesalers? If yes what are the terms of credit
- What are the debt recovery mechanisms?
- Do you any concern or see direct impact of resource condition on your business? Please explain.

Section 4:

- How do you earn an income from trading – e.g. by buying and selling, or by taking a commission for organizing sales?
- How long does fish usually remain in your possession? What is the maximum length of time? Is there any change in this over last 5-10 years?
- How do you store fish?
- How do you ensure that the fish you store remains in good condition?

- Do you experience any product losses during storage? Why/how much?
- Do you grade or clean the fish you store? Do you use any preservatives?
- Do you employ labour. If yes what kind of labour (male, female) you hire for what purposes. How many of the workers in this business are family members (if any)?
- What is the prevailing wage rate and practice of payment to workers?
- Is advance wage payment a common practice? If yes, how much and when is the advance paid?
- What do you think are the qualities of good worker?
- Have there been technological changes since you began to work in this profession that have changed the way your business operates?
- Would you categorize your trading business as small, medium or large? Why?
- Do you take credit for your business? If so, from what sources, on what terms? How about 5, 10 years ago? Why has this changed?
- Are you a member of any business association? Which and why?
- Does the association mediate disputes? Can you give an example?
- Does the association/s have any political power or influence – describe
- Which months are high/low season for sales? Why has this changed?
- What are the main locations (markets/areas) that you sell each of the main species/products to?
- Is any of the fish you sell exported? Give details
- What type of customers do you usually supply fish to (e.g. traders in other wholesale markets market, local retailers etc.)?
- What mechanisms you have to maintain the customer base. Is there any change in practice in last 5-10 years time.
- Do you provide credit to any of your customers?
- How common is this (e.g. what % of sell you provide as credit?) How about 5, 10 years ago? Why has this changed?
- What are the terms of the credit you provide (e.g. value, form, duration, interest)?
- How do you ensure that customers who take credit repay their debts?
- How did you enter into the profession? What are the key motivations?
- What are the key skills necessary to doing this job well?
- How did you learn these skills?
- Which aspects of your work do you like? Which aspects do you dislike?

- What are the most significant changes that have affected your business during past 10 years (positive and negative)?
- How has consumer demand for fish traded through this market changed within the past 10 years? How? What do you think are the reasons for these changes?
- Is there a specific technological preferences (eg. Solar drying, enclosed and covered drying etc.)
- What do you think the prospects are for your businesses over the next 10 years?
- What are the biggest challenges that you face when doing business?
- Do you consider your livelihood to be risky? Why/Why not?
- Is this a choice of employment that you would recommend to others? Why/why not?
- How do you think people in society generally perceive your profession?
- Would you be happy for your children to carry on this profession?
- How do you deal with supply fluctuations due to unseen forces?
- Do you have to go for standards and certification measures? If yes what are those standards and how do you comply to them?
- Is there any supply skewness due to low catch, what measure do you take to protect the fisheries?
- Do you consume dried fish? Why/why not? Which species do you prefer and why?
- Have you ever received any received any support or help from government, NGOs or any other organization (give details)?

Are there any government regulations, policies, or activities that restrict or cause difficulties for your business (give details)?

Appendix B: Ethics

COVID-19 Field/off-campus work SAFETY Plan Template for research with human participants

Introduction

This is a safety plan template and is based upon the hierarchy of controls model of risk management. The premise is to prioritize and implement controls that are known to be most effective (removing/eliminating exposure vs using PPE). The image in Figure 1 depicts this model using COVID-19 specific controls.

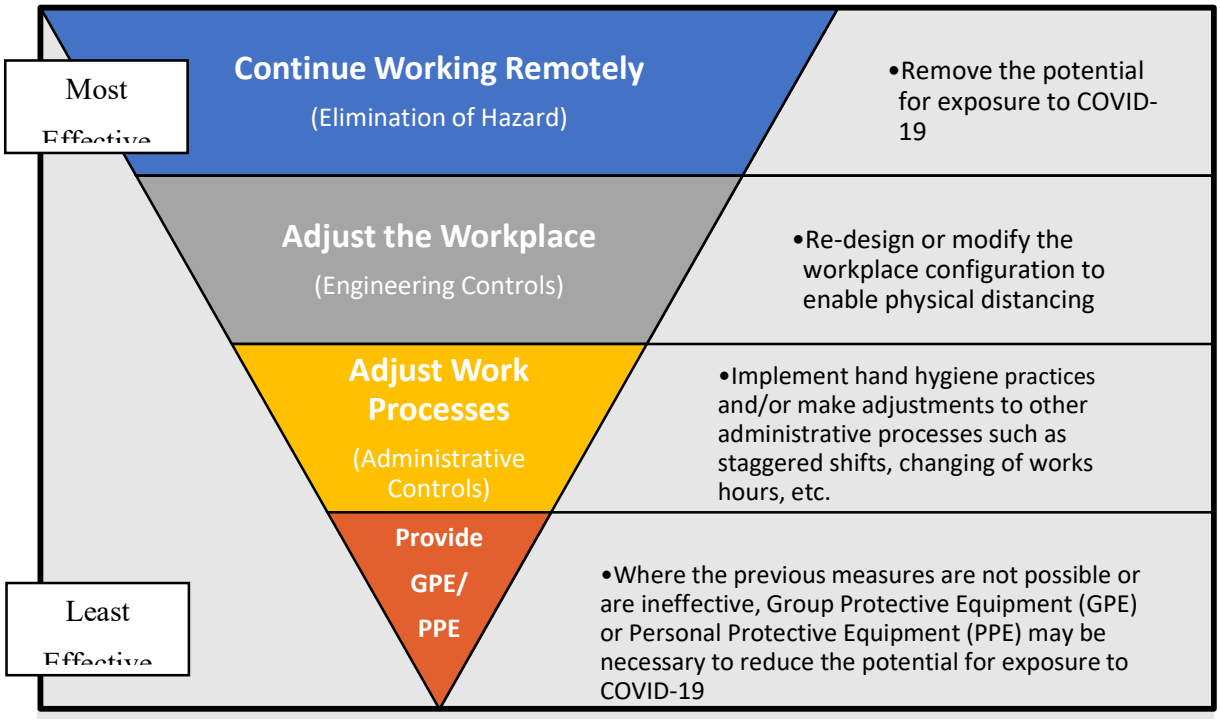

Figure 2: Hierarchy of controls as it applies to COVID-19

Purpose

This document has been designed to assist principal investigators and researchers in establishing appropriate protocols to minimize risk for field/off-campus work occurring in-person with human participants during COVID-19. Off campus human participant research applies to studies conducted in locations other than UWaterloo campuses and includes but is not limited to the following:

- Public spaces (parks, streets, town squares)
- Private indoor and outdoor settings (homes, properties, offices, businesses)
- Spaces under the jurisdiction or authority of an organization or entity (e.g., schools, community centers, other post-secondary institutions, government offices, etc.)
- Health facilities and clinics under the authority of a health authority, hospital, health region
- Lands and facilities under the authority of an Indigenous nation(s) or controlled access community (e.g., Mennonite community)

Instructions for use

Sections in Part A do not require any data to be submitted, they may be left blank. All sections in Part B must be completed.

To use this template, **insert your instructions in the relevant sections.** Once complete, review with all fieldwork employees, supervisors, students, and relevant persons at the host site/location(s).

Review involves going through the processes you have established and getting acknowledgement from all members of the work/research group and relevant persons at the host site/location(s) that they understand and will comply with the plan.

Notes

- Develop one plan per fieldwork project
- A Fieldwork Risk Management Form must also be approved
- You will need to obtain acknowledgement from all fieldwork employees, supervisors, and students
- You will need to sign the plan at the end signifying that you will enact the plan as outlined as well as be accountable for enforcing this plan
- At minimum, all fieldwork/off-campus research safety plans should contain the following elements:
    - Activities that do not require in-person interactions with study participants are to be done remotely

- Meetings or contacts with study participants to arrange visits, complete questionnaires, and consent should be held virtually or by phone
- Suitable pandemic safety precautions must be in place at all times, including physical distancing and hand hygiene
- You will need to understand and demonstrate in this plan how you intend on meeting the COVID-19 protocols for any region/province community, and or organization that you will be visiting. Please reference these where applicable. If requirements differ between the those used here at UW, and another location, you are expected to the more prescriptive requirements.
- All research must be conducted in accordance with applicable safety requirements and best practices
- No operation or fieldwork should be carried out without adequate training and supervision
- The Working Alone Guideline must be followed when deploying employees or students in any operation or fieldwork
- Fieldwork requiring use of a boat is not permitted unless physical distancing of at least two meters can be maintained
- Travel to, or in proximity to, Indigenous communities or on Indigenous land to undertake field research is normally not permitted
- International travel is not permitted, including to the USA,and domestic travel will be assessed on a case-by-case basis
- Permissions must be obtained and be current for use of off-campus locations or facilities (e.g., businesses, organizations, field stations, greenhouses, farms, municipal land) by the authority responsible for these locations or facilities
    - These updated permissions will need to be in place before your field work research request is given final approval
    - Respect the wishes to limit visitors to and from these areas
    - Permission to access national and provincial parks must be obtained from the relevant authorities
- Appropriate precautions must be in place and documented to protect employees, students, and the larger community

- Limit interaction with the general public
- Avoid sharing equipment
- The designation and frequency for cleaning of equipment, vehicles, field stations and other high-touch surfaces
- An outline of when non-medical masks are required

PART A

1.0 Employee Training

Before performing fieldwork or coming back to campus, employees, students, and researchers must complete the following training:

- Mandatory "Return to Campus Safety during COVID-19" (SO 2036) online training
- Training from the PI on the new practices outlined in this procedure

2.0 Responsibilities

2.1 Supervisor

- Develop this plan to meet Health & Safety Guidance during COVID-19 and any requirements for any host site(s) or location(s) being visited.
- Prior to deployment, meet with your employees, students, and research team prior to starting fieldwork. Orientation shall cover all items within this plan.
- Prior to deployment, discuss the requirements of this plan with relevant contact person(s) at the host site(s) or location(s).
- Enforce all criteria within this plan.
- Ensure appropriate hand hygiene and surface disinfection supplies are provided to all fieldwork employees, students, and research team.
- Actively review site/location pandemic and travel advisories in case adjustments to research protocols must be made.
- Review this plan at least monthly to:
    - Identify hazards as per the Occupational Health and Safety Act
    - Ensure the adequacy and adherence to this safety plan.

2.2 Employees and Students

- Follow all guidance within this plan.
- Notify their supervisor if supplies are not sufficient to maintain hand hygiene and surface decontamination requirements.
- Notify their supervisor of any hazards that are discovered while working.

- Do not conduct field/off-campus work if ill and report all illnesses using the process outlined in section 3.2 Illness and Absence Reporting.

3.0 Health Protocols

3.1 Self-Assessment Screening

To minimize risk, it is imperative that employees and students do not come to campus or conduct field/off-campus work when ill. For this reason, the University requires that employees and students monitor themselves daily for symptoms of COVID-19. The COVID-19 self-assessment tool, found in the WatSAFE app and on the University's Health Protocols site, provides clear directions on how to self-assess.

3.2 Illness and Absence Reporting

Do not participate in fieldwork or allow a member of your team to participate if exhibiting COVID-19 symptoms. Review and follow the University's Health Protocols at all times.

4.0 Hand Hygiene

Hand hygiene should be performed regularly throughout the day. At minimum, fieldwork employees, supervisors, students, and study participants shall wash hands or perform hand sanitization:

- After using the washroom, before eating, and when finished work for the day
- When they remove gloves
- After using shared equipment

Hand washing is the preferred method of hand hygiene. If hands are soiled (dirt, debris, oils, grease, and other contaminants), hand sanitizers will not be effective. Use soap and warm water in these cases. If work consistently causes hands to be soiled, hand washing facilities need to be provided and accessible (portable water jug/sink and soap).

Communicate these requirements to your employees and students before they embark on field/off-campus work.

5.0 Personal PRotective Equipment (PPE)

Physical distancing must be implemented whenever possible. However, even when practicing physical distancing, all researchers and participants must both wear ASTM Level 2 medical masks for the duration of the study. There will only be limited situations where removal of a

participant's mask may be permitted. In order to determine if this is permissible, please provide details of any proposed mask removal in your study design.

In addition, when 2m cannot be maintained between persons interacting for more than 15 minutes (cumulatively over a period of 24 hours), protective eyewear (in addition to masking) is strongly recommended. The reasoning for this is as follows: if one of the persons interacting tests positive, the other individual is considered a "high risk close contact" when eye protection is not worn. High risk close contacts must go through stricter self-monitoring and isolation procedures than contacts.

5.1 Exception for Participant Masking

If research involves children below the age of 3, masking is not recommended by public health. In this situation, researchers must wear N95 masks and protective eyewear when work requires the researcher to be within 2m of the child. For school aged children in grade 3 or below, masking is encouraged but not mandatory. Should these children not tolerate masks (fidgeting and constant touching), the researcher should wear an N95 mask and protective eyewear when within 2m of the child. If a researcher is required to wear an N95 mask, they will require fit testing. The researcher is advised to contact the Safety Office for this.

5.2 Other Protective Equipment

- Gloves are required where there is human contact. Gloves shall not be used in hallways (this rule has not changed).
- Eye protection can include appropriate safety glasses/goggles or a face shield (available via Central Stores) and must:
    - Fit properly and not interfere with the proper fit of a mask
    - Provide a barrier to splashes from the side
    - Not create an additional hazard in relation to the type of work being performed

  Face shields, safety glasses and safety goggles must be individually provided and wiped with a disinfectant before and after each use.
- Aprons should be wiped with disinfectant before and after each use.
- Shared computers should have plastic keyboard covers and be wiped with disinfectant before and after each use.

- Lab coats are required for any work involving human participant research. Lab coat use must follow these requirements:
    - Lab coats shall be designated to an individual and NOT shared
    - Lab coats shall be stored in the laboratory in which they are used
    - At a minimum, lab coats shall be washed if they are visibly soiled, known to have been contaminated, or have been used while cleaning up fluids/materials of biological origin. If none of the above apply, lab coats shall be washed after 10 uses.
    - Lab coats may be used for multiple participants provided none of the above have occurred.
- Scrubs may be used in place of lab coats provided the following criteria are used:
    - Scrubs shall be designated to an individual and not shared.
    - Street clothes are worn to the facility, then the individual changes into their scrubs once on-site. Once the study work for the day is complete, the individual will change back into their street clothes and place the scrubs into a plastic bag for transport and laundering.
    - At a minimum, scrubs shall be washed after each day of use. If the scrubs have been visibly soiled, known to have been contaminated, or have been used while cleaning up fluids/materials of biological origin, they shall be changed immediately, and placed into a plastic bag for transport and washing.
    - Scrubs may be used for multiple participants provided none of the above have occurred.
- Researchers are to wear surgical masks, face shields, lab coats or disposable gowns, and gloves for studies that involve taking biological fluids (e.g., spit, blood, other bodily fluids) and the participants are to wear Level 2 masks.

PART B

Principal Investigator: Sisir Kanta Pradhan (in India and will do the research)

Supervisor: Prateep Kumar Nayak (will continue to remain Canada)

Field/Off-campus Location: Odisha and West Bengal, India_____

1.0 Adjust the workplace - Physical Distancing

- Outline the plan to ensure that 2m physical distancing can be maintained in the field or when off-campus.
    - Include distancing between fieldwork employees, supervisors and students, between study participants and local contacts, and the public.
- Outline safety measures to ensure fieldwork employees, supervisors and students travel safely to and from the field site(s)/study location(s).
- Outline safety measures if accommodations are required, including how fieldwork employees, supervisors and students will be separated with respect to:
    - Sleeping quarters
    - Washroom facilities
    - Meal plans, including food preparation and eating (e.g., how will these plans protect fieldwork employees, students, research team, and the community?)

Describe your plan here. Note any specific measures regarding GPE that need to be addressed for the work/study conditions.

Sisir will follow the Covid-19 protocol regarding physical distancing issued by Government of India and practices described under UW ethics.

Sisir is in Odisha, India since June 2020. Hence there is no need of quarantining on arrival. He has already gone through mandatory quarantine process and also vaccinated by Indian public health system. The research location covers to contiguous states within a distance of 250 kilometers. Since Sisir is in the study location for about a year now, and his native is Odisha he is familiar with local routes, government protocols and the covid situations at different places.

It does not involve any air travel and the field commuting will be done by Car. he will use personal vehicle for local travel that reduces the chance of infection to a great extent. The

vehicle is insured and the study geography is contiguous spreading across Odisha and West Bengal. Hence the travel does not involve long distances, it is not required to take enroute breaks In case of using toilets if need arises, all social distancing norms, disinfectant spray and face masks will be used. Field sites are also quite accessible by car. While travelling, home made food and water will be carried to avoid outside eating. It might involve overnight accommodation and all necessary Covid-19 guidelines will be followed including sanitization of hotel rooms. As per the government norms, all the hotels that are covid compliant can only have the permission for admitting guests into their hotel. Moreover, the hotel stay will be very brief maximum upto 3 days keeping in mind the availability of traders, wholesalers and policy makers. During the stay at hotel, he will avoid the use of continental breakfast/buffet areas, housekeeping services, and minimize the use of hotel common areas for the duration of stay." While food will be carried from home, in case of essential eating, in-room dining will be preferred. As per the local public health guideline, interstate travel between Odisha and West Bengal does not involve any restriction other than that of a vaccination certificate. Sisir has necessary vaccination certificate which is attached for ready reference

Lockdown has been lifted from most of the places after the second wave of Covid from April to June. The protocols are available in the government of India website. (https://www.mha.gov.in/notifications/circulars-covid-19). However, all Covid-19 protocols with regards to social distancing and personal safety will be practiced with utmost care. The social distancing rule of Government of India suggests to wear double masks, frequent handwashing and sanitization, avoid group interactions and meetings, maintain 2 meter distance and carrying own food or order on line take away food. At the provincial government level, the situation is dynamic and based on the positivity rate at any given point of time, the states have power to declare lockdowns and containment zones. When lockdown is imposed, more stringent measures are adopted including closure of commercial establishments, suspension of public transport, non-essential travel and limited participation in social and cultural events.

Considering the Covid situation verbal permissions from the community members, dried fish processors, traders and wholesalers will be obtained to access their operational locations. The researcher will ensure 2-meter physical distance and use masks to cover the nose and mouth during interaction with research participants and local contacts. In addition, he will ensure that all disinfection protocols for the seating will be used during surveys and interviews. The chairs (if used) will be disinfected through disinfectant spray and all the participants will be

advised to sanitize hands in every ten minutes. Each study participant will be provided with ASTM level 2 rated medical face masks and 100 ml bottle of sanitizer with 70% isopropyl alcohol.

I will maintain the mandatory travel requirements while traveling in the field location. Since I am located in the field location and it involves local travel. I will use separate vehicle while travelling in the field site. As a practice I will carry cooked food and water with myself for most of the time. In case of overnight stay out of my place of accommodation, I will ensure to stay in facilities that are following the public health guideline issued of Government of India and provincial government.

“Hand washing with soap, water, and paper towels will be preferred, and will be used instead of/in addition to hand sanitizer, when available. He will carry sanitization and handwash with him always and he will encourage all the research participants and research assistants working with me to strictly follow the covid public health guidelines on maintaining physical distancing. “Research assistants will wear masks inside of public buildings (public washrooms, petrol pumps, etc.), and in any situation where 2m physical distancing cannot be maintained. “hand sanitizer will always be available within vehicles, and on workers when in the field. Hand hygiene will take place when entering/exiting indoor public spaces, public washrooms, vehicle, before eating, after refuelling, and after touching face mask.

He will focus more on key informant interviews and survey that would be mostly one to one interaction. The place of accommodation including the personal dwelling and hotel room will be sanitized on a regular basis using approved alcohol-based sanitizers (70% isopropyl alcohol).

1.1 Activities with / by study participants

Please describe in detail the nature of all activities involved in the study that involve interaction with participants. Be as specific as possible. Be clear which activities if any require a researcher being in close proximity (within 2m) of a participant and provide an estimate of the duration. Activities that require close proximity should be minimized.

Survey and personal interviews will be conducted at the location of study participants, mostly at their corridor or in the worksite. Efforts will be made to conduct the survey and personal interviews in an open space. Each survey will take about 45 minutes and personal interview will take about maximum 90 minutes.

Since all the data collection will be made through personal interview, there is a little possibility of congregation of people. Social distancing norms will be ensured through appropriate seating arrangements of maintaining at least 2 meter distance, wearing of face mask and ensuring frequent hand sanitization.

He will also provide ASTM level 2 rated medical face masks to participants, and all individuals participating in study will wear medical masks during interviews, and survey work.

Total estimated cumulative time in close contact: 2 minutes_____

2.0 Surface Decontamination

Surface decontamination of work areas and equipment is the responsibility of the supervisor or PI. At minimum, most surfaces should be disinfected twice per day. Fill out the sections below to outline decontamination plans.

Please note that the research work does not involve installation of any equipment or any specific space to be used on a recurrent basis.

2.1 SHARED equipment Decontamination

Complete the table below regarding the disinfection details for the shared equipment (including vehicles) when in the field/off-campus activities.

Table 0.1: Shared equipment disinfection details

Equipment Identifier	Disinfectant	Concentration	Contact time	Frequency of disinfection
Equipment used with and by employees				
Camera to click photographs	Disinfecting wipes	70% Isopropyl alcohol	2 minutes	Twice a day, and between users

Notes on surface disinfection:

- Ensure the disinfectant chosen is appropriate for the surface being disinfected.
- Ensure there is enough disinfectant to last for the course of the fieldwork.
- All work surfaces should be decontaminated twice daily. In most situations, this means before work begins and once work has concluded.

2.2 High-touch area Decontamination (indoor areas)

All high-touch surfaces should be disinfected twice daily. Designate responsible persons and a schedule for this to be done. Complete the table below.

Table 0.2: High touch surface disinfection summary table.

Item Identifier	Disinfectant	Responsible Person	Schedule	Frequency of disinfection
Doorknobs, cupboard handles, kitchen appliances	Recommended disinfectant available in pharmacy stores	Self	Everyday morning and after returning from field work	Twice a day
Faucets and washroom fixtures	Recommended disinfectant available in pharmacy stores	Self	Everyday morning and after returning from field work	Twice a day
Light switches	Recommended disinfectant available in pharmacy stores	Self	Everyday morning and after returning from field work	Twice a day
Vehicle steering wheel, door handles	Recommended disinfectant available in pharmacy stores	Self	Everyday morning and after returning from field work	Every time I use the car

Click here for more information on the disinfection of surfaces:

3.0 contingency plan

All field/off-campus work is required to have a contingency plan. This must describe actions that will be taken if a fieldwork employee, supervisor, or student has symptoms of COVID-19, tests positive for COVID-19, or is required to self-isolate. It must include actions to be taken if a study participant has symptoms of COVID-19 or tests positive for COVID-19. It also includes the need to immediately respond to University, regional or provincial directions to cease field/off-campus work operations. Responsibility must be assigned to individuals within your group to ensure that field/off-campus work can be safely and appropriately scaled back or stopped on short notice, including travel and accommodation needs. Ensure you reference any requirement of the Region, Province, or area you are in if they are different than the ones used at Waterloo.

Describe your contingency plan here:

The field work will be conducted by following the guidelines issued by central and state government of the research country i.e. India. As per the directives, he will use ASTM level 2 rated medical face masks and gloves during the field work. If the researcher develop any symptoms, he will immediately quarantine himself and opt for the Covid 19 test from the designated testing facilities. To avoid contact with research participants with Covid symptoms, the interview and survey process will be cancelled. The public health official of the local area will be informed about that. Immediate RTPCR test will be conducted for Sisir and local research assistant without taking any chance. Similarly, if a study participant has symptoms of COVID-19, or tests positive for COVID-19, the public health official of the local area will be informed, all study participants (if any that were present other than a single participant for interview etc.) present in the specific research activity will be contacted immediately and informed about this development, and be advised to go to the nearest government COVID testing facility, and immediate RTPCR test will be conducted for Sisir and local research assistants. Sisir will also be in touch with these people remotely until the time their test results have come out negative. He will inform about his and participants wellbeing to his supervisor immediately if such situation arises. “If a worker/researcher tests positive, they should inform University of Waterloo Occupational Health (OH) immediately at 519-888-4567 extension 40538 or 46264, or at occupationalhealth@uwaterloo.ca”. If Sisir has scheduled activities that involve other person, he will immediately inform him or her about his health and he will cease all activities following the quarantine guideline.

4.0 Acknowledgements

Field/off-campus employee, supervisor and student acknowledgements

By printing and signing my name in the table below, I acknowledge that I have been trained on the procedures outlined in this document, that I have been consulted and have no reservations with the safety precautions and processes that will be in place to conduct research described in the request to conduct fieldwork.

Employee Name	Signature	Date
Sisir Kanta Pradhan		27 September 2021

Principal Investigator acknowledgement

I acknowledge that I am responsible for the implementation of all procedures outlined in this document to reduce infection risk of COVID-19. Those found not following these directives will be subjected to corrective action up to and including disciplinary measures.

Principal Investigator name: Sisir Kanta Pradhan

Principal Investigator signature: **Date:** 27 September 2021

Supervisor Name: Prateep Kumar Nayak

Principal Investigator signature: **Date:** 27 September 2021

Letter of Ethics approval

Sisir Pradhan

From: no-reply=kuali.co@mx3.kuali.co on behalf of Kuali Notifications <no-reply@kuali.co>
Sent: Friday, October 29, 2021 12:50 AM
To: Sisir Pradhan
Subject: Research Ethics - Renewed application # 41888 has ethics clearance

Dear Prateep Nayak and other members of the research team:

Your application has been reviewed by Delegated Reviewers. We are pleased to inform you the **Renewed application for 41888 Dried Fish Matters; Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition** has been given ethics clearance.

Note: Due to the current COVID-19 situation, research activities that require face-to-face/in-person interactions cannot be conducted until all procedures for research re-start (including safety plan approval) have been completed. For all in-person research protocols please review Frequently Asked Questions, processes and forms, and restart guidance. Direct any inquires to researchethics@uwaterloo.ca.

This research must be conducted in accordance with the most recent version of the application in the research ethics system and the most recent versions of all supporting materials.

Ethics clearance for this study is valid until Saturday, January 14th 2023.

The research team is responsible for obtaining any additional institutional approvals that might be required to complete this Expedited study.

University of Waterloo Research Ethics Boards operate in compliance with the institution's guidelines for research with human participants, the Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS, 2nd edition), Internalization Conference on Harmonization: Good Clinical Practice (ICH-GCP), the Ontario Personal Health Information Protection Act (PHIPA), and the applicable laws and regulations of the province of Ontario. Both Boards are registered with the U.S. Department of Health and Human Services under the Federal Wide Assurance, FWA00021410, and IRB registration number IRB00002419 (Human Research Ethics Board) and IRB00007409 (Clinical Research Ethics Board).

Renewal: Multi-year research must be renewed at least once every 12 months unless a more frequent review has been specified on the notification of ethics clearance. This is a requirement as outlined in Article 6.14 of the Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS2, 2014). The annual renewal report/application must receive ethics clearance before Thursday, December 22nd 2022. Failure to receive ethics clearance for a study renewal will result in suspension of ethics clearance and the researchers must cease conducting the study. Research Finance will be notified ethics clearance is no longer valid.

Amendment: Changes to this study are to be submitted by initiating the amendment procedure in the research ethics system and may only be implemented once the proposed changes have received ethics clearance.

Adverse event: Events that adversely affect a study participant must be reported as soon as possible, but no later than 24 hours following the event, by contacting the Director, Research Ethics. Submission of an adverse event form is to follow the next business day.

Deviation: Unanticipated deviations from the approved study protocol or approved documentation or procedures are to be reported within 7 days of the occurrence using a protocol deviation form.

1

Incidental finding: Anticipated or unanticipated incidental findings are to be reported as soon as possible by contacting the Director, Research Ethics. Submission of the incidental findings form is to follow within 3 days of learning of the finding. Participants may not be contacted regarding incidental findings until after clearance has been received from a Research Ethics Board to contact participants to disclose these findings.

Study closure: Report the end of this study by submitting a study closure report through the research ethics system.

Coordinated Reviews: If your application was reviewed in conjunction with Wilfrid Laurier University, Conestoga College, Western University or the Tri-Hospital Research Ethics Board, note the following: 1) Amendments must receive prior ethics clearance through both REBs before the changes are put in place, 2) PI must submit the required annual renewal report to both REBs and failure to complete the necessary annual reporting requirements may result in Research Finance being notified at both institutions, 3) In the event that there is an unanticipated event involving a participant that adversely affects them, the PI must report this to both REBs within 24 hours of the event taking place and any unanticipated or unintentional changes which may impact the research protocol shall be reported within seven days of the deviation to both REBs.

Initial application ethics clearance notification: Your clearance notification will be added to the record within 24 hours. Go to "Admin Notes and Files" in the research ethics system (right-hand side) to print a copy of the initial application ethics clearance notification.

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Best wishes for success with this study.

If you have any questions concerning this notification, please contact the Research Ethics Office or email researchethics@uwaterloo.ca.

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PROTOCOLS

UNIVERSITY OF WATERLOO

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Manage Protocols → Humans: #41888 Dried Fish Matters; Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition

Protocol | Activity Log | Permissions

Protocol Version Permissions

Manage access to this and future protocol versions for individuals whom are not involved in the research stud
They might include Research Coordinators, Hospital Administrative staff, or temporary persons like regulatory officials doing a review.

Search users

Name	Permission Type
PN Prateep Nayak PNAYAK	**Full Access** (User's permissions can be updated in the person select
DA Derek Armitage DRARMITA	**Full Access** (User's permissions can be updated in the person select
SP Sisir Pradhan S4PRADHA	**Full Access** (User's permissions can be updated in the person select
IG Iroshani Galappaththi IGALAPPA	**Full Access** (User's permissions can be updated in the person select

Recruitment and consent

Consent to Use Video and/or [Digital Images or Photographs] in Teaching, Presentations, and Publications

Sometimes a certain [image or photograph] and/or part of a videotape clearly show a particular feature or detail that would be helpful in teaching or when presenting the study results
at a scientific presentation or in a publication. These photographs and videos will be used for both research analysis and sharing.

I am aware about video and/or [digital images or photographs] in which I appear to be used in research analysis, teaching, scientific presentations and/or publications with the understanding that I will not be identified by name. I am aware that I may withdraw this consent at any time without penalty.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (Ethics: ORE #41888). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact [insert researcher's name and contact information].

I agree to allow that the digital images and videos in which I appear to be used in analysis and interpretation for research purpose.

☐YES ☐NO

I am aware about video and/or [digital images or photographs] in which I appear to be shared through teaching, scientific presentations and/or publications.

☐YES ☐NO

Recruitment and Verbal Consent Letter: Field Interviews

Title of Project: ***Dried Fish Matters:*** Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition

Name of the Interviewer*: [Name of the researcher conducting the interview to be inserted]*

Dear Participant,

To help you make an informed decision regarding your participation in the study, this letter will explain what the study is about, the possible risks and benefits, and your rights as a research participant. Please note that this letter is separate from the COVID-19 related verbal consent that you just provided. If you do not understand something in the letter, please ask one of the investigators prior to consenting to the study. You will be provided with a copy of the information and consent form if you choose to participate in the study.

I. About the Study

The study is about developing an understanding of dried fish systems in India. The research will examine the value chain complexities by applying a social-ecological systems, governance and gender perspective to value creation across the value chain. This will offer nuanced understanding of human socio-economic activity in the dried fish value chain in the context of social, ecological, cultural, historical, political and other forces. This study is part of a larger international and collaborative research "Dried Fish Matters; Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition". The research engagement of University of waterloo is limited to various study sites in India. The study will be conducted through Environment, Enterprise and Development (SEED), University of Waterloo, Canada and School of Environment, Resources and Sustainability under the supervision of Professors Prateep Kumar Nayak and Derek Armitage. As you may already know, dried fish has a strong social-ecological and economic function to the life and livelihoods of people engaged at various stages of dried fish operation. Because you are an active member of dried fish value stream, your opinion may be important to this study. Thus, I would appreciate the opportunity to speak with you about this.

II. Your responsibilities as a participant

What does participation involve?

Participation in this study is voluntary and would involve a 45 – 60 minutes interview in your home or alternate location at a convenient location and time. You will first complete a short demographic information (age, gender, religion, no of children, roles in dried fish value chain etc.), and then I will seek opinion on various questions with regard to different social, ecological and economic dimensions of dried fish value chain. You may decline answering any questions you do not wish to answer, and you may end the interview at any time by advising me of this decision.

Who may participate in the study?

In order to participate in the study, you must be at least 18 years of age and an active member of fishing communities. You must also not belong to any groups considered vulnerable with respect to COVID-19 (e.g., an older adult; underlying medical conditions such as heart disease, hypertension, diabetes, chronic respiratory diseases, cancer, etc.; or a compromised immune system).

II. Your rights as a participant

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline answering any questions you do not wish to answer, and you may end the interview at any time by advising me of this decision. All information that could identify you will be removed from the data we have collected within 24 months and stored separately. We will keep identifying information for a minimum of seven years and our study records for a minimum of seven years. You can withdraw consent to participate and have your data destroyed by contacting us within this time period. Only those associated with this study will have access to these records which are password protected. It is not possible to withdraw your consent once papers and publications have been submitted to publishers. All records will be destroyed according to the data storage and management policy of the University of Waterloo, Canada.

What are the possible benefits of the study?

Participation in this study may not provide any personal benefit to you. I hope the information collected through this interview will aid in strengthening dried fish sector and protect the interest of dried fish value chain actors with nuanced knowledge and analysis.

Are there any other risks associated with the study in addition to the risk of exposure to COVID-19 as we discussed before?

There may be some minor risks to participating in our study, in addition to the risk of COVID-19 exposure. Our questions are about your work where you may have competition or conflict with others. We will be protecting your information and will only use it for research to help your industry and community. Also, other people may know that you participated in the interview, but we will not share any of your answers or anything else that you tell us. Real names will be confidential and stored separate from the study data. I will explain in more detail our privacy measures further down/in a moment. If a question, or the discussion, makes you uncomfortable, you can choose not to answer. Your participation is voluntary as we discussed before.

Will my identity be known to others?

Your participation in this study will be considered confidential. Your name will not be used in any paper or publication resulting from this study, however with your permission anonymized quotations may be used. Identifying information will be removed from the data that is collected and stored separately. If you have any questions about participation, please feel free to discuss these with the interviewer, or later, by contacting the Principal Investigator of this study Prof. Prateep Kumar Nayak at (1)519-888-4567, Ext. 33112.

Will my information be kept confidential?

The data collected will be kept in PI's office/lab at the University of Waterloo to help maintain baseline data for future. All the interview forms will be coded to replace any real names and they will then exist on record separately. Identifying information will be removed from the data that is collected and stored separately. Only those associated with this project will have access to study records.

III. Questions, comments, or concerns

Who is sponsoring/funding this study?

This study is supported by the Social Sciences and Humanities Research Council of Canada and being implemented in five countries of South and South-East Asia.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee **[**ORE # 41888**].** If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study? If you are interested in receiving a copy of the executive summary of the session outcomes, please contact Prof. Prateep Kumar Nayak at pnayak@uwaterloo.ca; Tel: 1-519-888-4567, Ext. 33112. For all other questions contact **[Sisir Kanta Pradhan 1-519-897-5254].**

Thank you for your assistance with this research.

Yours sincerely,

Researcher

Recruitment and Verbal Consent Letter: Survey

Title of Project: ***Dried Fish Matters:*** Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition

Name of the Interviewer*: [Name of the researcher conducting the interview to be inserted]*

Dear Participant,

To help you make an informed decision regarding your participation in the study, this letter will explain what the study is about, the possible risks and benefits, and your rights as a research participant. Please note that this letter is separate from the COVID-19 related verbal consent that you just provided. If you do not understand something in the letter, please ask one of the investigators prior to consenting to the study. You will be provided with a copy of the information and consent form if you choose to participate in the study.

I. About the Study

The study is about developing an understanding of dried fish systems in India. The research will examine the value chain complexities by applying a social-ecological systems, governance and gender perspective to value creation across the value chain. This will offer nuanced understanding of human socio-economic activity in the dried fish value chain in the context of social, ecological, cultural, historical, political and other forces. This study is part of a larger international and collaborative research "Dried Fish Matters; Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition". The research engagement of University of waterloo is limited to various study sites in India. The study will be conducted through Environment, Enterprise and Development (SEED), University of Waterloo, Canada and School of Environment, Resources and Sustainability under the supervision of Professors Prateep Kumar Nayak and Derek Armitage. As you may already know, dried fish has a strong social-ecological and economic function to the life and livelihoods of people engaged at various stages of dried fish operation. Because you are an active member of dried fish value stream, your opinion may be important to this study. Thus, I would appreciate the opportunity to speak with you about this.

II. Your responsibilities as a participant

What does participation involve?

Participation in this study is voluntary and would involve a 45 – 60 minutes interview in your home or alternate location at a convenient location and time. You will first complete a short demographic information (age, gender, religion, no of children, roles in dried fish value chain etc.), and then I will seek opinion on various questions with regard to different social, ecological and economic dimensions of dried fish value chain. You may decline answering any questions you do not wish to answer, and you may end the interview at any time by advising me of this decision.

Who may participate in the study?

In order to participate in the study, you must be at least 18 years of age and an active member of fishing communities. You must also not belong to any groups considered vulnerable with respect to COVID-19 (e.g., an older adult; underlying medical conditions such as heart disease, hypertension, diabetes, chronic respiratory diseases, cancer, etc.; or a compromised immune system).

II. Your rights as a participant

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline answering any questions you do not wish to answer, and you may end the interview at any time by advising me of this decision. All information that could identify you will be removed from the data we have collected within 24 months and stored separately. We will keep identifying information for a minimum of seven years and our study records for a minimum of seven years. You can withdraw consent to participate and have your data destroyed by contacting us within this time period. Only those associated with this study will have access to these records which are password protected. It is not possible to withdraw your consent once papers and publications have been submitted to publishers. All records will be destroyed according to the data storage and management policy of the University of Waterloo, Canada.

What are the possible benefits of the study?

Participation in this study may not provide any personal benefit to you. I hope the information collected through this interview will aid in strengthening dried fish sector and protect the interest of dried fish value chain actors with nuanced knowledge and analysis.

Are there any other risks associated with the study in addition to the risk of exposure to COVID-19 as we discussed before?

There may be some minor risks to participating in our study, in addition to the risk of COVID-19 exposure. Our questions are about your work where you may have competition or conflict with others. We will be protecting your information and will only use it for research to help your industry and community. Also, other people may know that you participated in the interview, but we will not share any of your answers or anything else that you tell us. Real names will be confidential and stored separate from the study data. I will explain in more detail our privacy measures further down/in a moment. If a question, or the discussion, makes you uncomfortable, you can choose not to answer. Your participation is voluntary as we discussed before.

Will my identity be known to others?

Your participation in this study will be considered confidential. Your name will not be used in any paper or publication resulting from this study, however with your permission anonymized quotations may be used. Identifying information will be removed from the data that is collected and stored separately. If you have any questions about participation, please feel free to discuss these with the interviewer, or later, by contacting the Principal Investigator of this study Prof. Prateep Kumar Nayak at (1)519-888-4567, Ext. 33112.

Will my information be kept confidential?

The data collected will be kept in PI's office/lab at the University of Waterloo to help maintain baseline data for future. All the interview forms will be coded to replace any real names and they will then exist on record separately. Identifying information will be removed from the data that is collected and stored separately. Only those associated with this project will have access to study records.

III. Questions, comments, or concerns

Who is sponsoring/funding this study?

This study is supported by the Social Sciences and Humanities Research Council of Canada and being implemented in five countries of South and South-East Asia.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee **[insert** ORE # 41888**].** If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study? If you are interested in receiving a copy of the executive summary of the session outcomes, please contact Prof. Prateep Kumar Nayak at pnayak@uwaterloo.ca; Tel: 1-519-888-4567, Ext. 33112. For all other questions contact **[Sisir Kanta Pradhan 1-518-897-5254].**

Thank you for your assistance with this research.

Yours sincerely,

Researcher

VERBAL CONSENT FORM FOR RSEARCH PARTICIPATION

(This is separate from the COVID-19 related verbal consent)

By agreeing to this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I understand the information presented to me about a study being conducted by [***researcher name to be inserted separately***] of the Faculty of Environment, University of Waterloo, Canada. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

Do you understand the information?

Are you aware that you have the option of allowing my interview to be audio recorded to ensure an accurate recording of your responses?

Are you aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous?

Are you aware that you may withdraw your consent up until results are submitted for publication or included in any other documents without penalty by advising the researcher?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee [insert ORE Ethics approval number here]. If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions, please contact **[insert researcher's name and contact information].**

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

I agree to have my interview audio recorded.

☐YES ☐NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

☐YES ☐NO

Verbal Consent: COVID-19 Risks for In-Person Research Study Visits

Researcher name and contact details:

Study Title:

This study is conducted as part of a Canadian-based Partnership Project titled *"Dried Fish Matters (DFM):* Mapping the social economy of dried fish in South and Southeast Asia for enhanced wellbeing and nutrition

Principal Investigator (DFM - UWaterloo): Prof. Prateep Kumar Nayak, Faculty of Environment, email: pnayak@uwaterloo.ca; Tel:1-519-888-4567, Ext. 33112

Name of the Interviewer*: [Name of the researcher conducting the interview to be inserted]*

Dear Participant,

As you know, the location of this field site, **[insert location]**, falls under the jurisdiction of **[insert public health name]**. We are putting in place safety precautions to reduce exposure to COVID-19 during these interviews, but the risk of exposure can still exist. We ask that you follow public health directives, as well, for the safety both of participants and researchers.

COVID-19 can result in severe illness, medical expenses, loss of income and death. **If you are feeling unwell or experiencing any of the following potential COVID-19 symptoms, then please discuss your participation with the research team before consenting**: new or worsening cough, shortness of breath or difficulty breathing, temperature equal to or over 38C (100.4F), feeling feverish, chills, fatigue or weakness, muscle or body aches, new loss of smell or taste, headache, gastrointestinal symptoms (abdominal pain, diarrhea, vomiting), or feeling very unwell.

Because the researcher may need to be closer to you than the recommend 2m distance, the following safety protocols must be followed:

- Answer questions for a **required COVID-19 screening assessment, which you did just before this letter.** Please **sanitize your hands** or wash them before we begin the interview. Hand sanitizer will be provided.
- Please **wear a mask or face covering throughout the interview duration**. Masks will be provided if required.
- Avoid touching the face or the mask.
- Advise a researcher if you believe a safety measure is not being taken, or that safety is at risk.
- Provide your **personal contact information** for contact-tracing purposes.

We will be collecting personal contact information that we must retain and will use only to **follow up with you or support contact tracing** if you may have been exposed to COVID-19 at the research site. Contact information will be **stored securely and separately** from research data, then **destroyed** as soon as permitted by public health authorities.

To reduce the possibility of COVID-19 exposure, especially if study procedures cannot maintain 2-metre distancing, we have implemented the **following safety procedures** recommended by our Safety Office and public health:

- Regular **hand sanitizing or washing** by all research team members,
- Availability and use of **hand sanitizer** for study participants and researchers,
- The voice recorders, cell phones, and pens used by the research term have been properly sanitized and each member has their own supply of these equipment to avoid sharing,
- Wearing of **face masks/face coverings** (A **face mask will be provided** for you if required).
- Where necessary, use of face shields and gloves, and
- All research members have taken COVID-19 self assessments this morning and have followed all safety guidelines during their commute to the field site.

If you feel that you are unable to wear a mask or you are from a vulnerable group with respect to COVID-19 (e.g., an older adult; underlying medical conditions such as heart

disease, hypertension, diabetes, chronic respiratory diseases, cancer, etc.; or a compromised immune system), please discuss your participation with the research team before consenting.

You are invited to participate in an in-person interview on a voluntary basis. You are **under no obligation to participate** and nothing will happen if you change your mind about participating in the research. At any time, you can stop participating or withdraw from the study by notifying the researcher.

As noted above, your information will be held for the time required by public health authorities for contact tracing purposes.

Thank you for your interest and participation.

Yours sincerely,

Researcher

Appendix C: Photographs from the field

A typical fisher village, Kajalapatia, Odisha, Photo: Pradhan, 2022

A fish landing site and semi structured interview with women, NM Padia village, Photo: Pradhan, 2022

Dried fish processing and interview with Processor, NM Padia village and Digha, Photo: Pradhan, 2022

Local Dried fish Market (Paradeep and Sunakhala), Photo: Pradhan, 2022