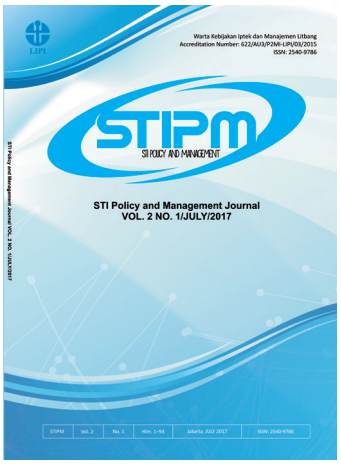

Journal of STI Policy and Management

Publication details, including instructions for authors and subscription information: http://www.stipmjournal.org/

The Innovative Policy Options for Coastal Fisheries Economic Development: A Case of Kwandang Bay Coastal Ecosystem

Noel Taylor-Moore
Australian Volunteer International

Version of record first published: 15 July 2017

To cite this article: Taylor-Moore, N. (2017). The Innovative Policy Options for Coastal Fisheries Economic Development: A Case of Kwandang Bay Coastal Ecosystem. *Journal of STI Policy and Management,* 2(1), 15–27

To link to this article: http://dx.doi.org/10.14203/STIPM.2017.73

ISSN 2540-9786 (Print); ISSN 2502-5996 (online)

Accreditation Number: 622/AU3/P2MI-LIPI/03/2015

JOURNAL OF SCIENCE, TECHNOLOGY AND INNOVATION POLICY AND MANAGEMENT (STIPM JOURNAL), Volume 02, Number 01, July 2017

FOREWORD by EDITOR-in-CHIEF

We are very pleased to inform readers that *Journal of Science, Technology and Innovation Policy and Management* (STIPM Journal) Vol. 2, No. 1, July 2017 is now ready for public reading.

The STIPM Journal is an online research journal managed by the Center for Science and Technology Development Studies at the Indonesian Institute of Sciences (PAPPIPTEK-LIPI). As a peer-reviewed journal, the STIPM Journal provides free access to research thoughts, innovation, and original discoveries mostly aimed at scholars.

In this edition, the STIPM Journal contains six articles dealing with science, technology and innovation policy and management written by scholars from Japan, Australia, and Indonesia.

The first article is entitled "Innovation Process of Natural Resource-based Firms in Four ASEAN Economies: A SEM Approach" by Masatsugu Tsuji, Hiroki Idota, Yasushi Ueki, and Teruyuki Bunno. Using a structural equation model (SEM), this paper discusses the innovation process in natural resource-based industries in Vietnam, Indonesia, the Philippines, and Thailand in comparison to other assembling and processing industries by focusing how factors affect product as well as process innovation.

The second article is written by Noel Taylor-Moore, entitled "The Innovative Policy Options for Coastal Fisheries Economic Development: A Case of Kwandang Bay Coastal Ecosystem". This article uses a policy innovation framework in the context of STI inputs and a multi-level perspective (MLP), selects a potential site in which a fisheries economic development hub would be implemented, and performs a SWOT analysis of the selected site as a hub.

Erman Aminullah, Trina Fizzanty, Karlina Sari, Rizka Rahmaida, and Qinan M. B. Soesanto present the third article, "Interactive Learning for Upgrading and Growth: Case of Indonesian Fishery Firms." This article discusses an interactive learning model for upgrading and growth in Indonesian fishery firms using the case of fish processing and aquaculture (shrimp). The model suggests that the dynamics of upgrading and growth through interactive learning will be able to continue in a stable manner as constraints from limiting elements are eased through: combating illegal fishing; encouraging interaction with universities; shifting to higher added-value products; increasing institutional support for global trading; preventing shrimp diseases; and providing infrastructure, business facilities, and regulation information.

The fourth article, entitled "Developing the Marine and Fisheries Industry in Pangandaran using a Bioecoregion-based Technopark Framework", is written by Atikah Nurhayati and Agus H. Purnomo. This article discusses how to establish a marine and fisheries technopark in Pangandaran. By using gap and SWOT analysis, it was found that particular recommendations for improvement should be made,

the existing bioecoregional environment and development variables in Pangandaran would support the development of a marine and fisheries technopark.

The fifth article, entitled "Development of National Technology Audit Policy", is presented by Subiyanto. This article discusses the concept of a national technology auditing policy, particularly with regard to infrastructure requirements, and with emphasis on technical regulation effectiveness and implementation tool readiness. This article discusses setting a policy agenda by discussing the governance aspect of national technology auditing.

The final article is written by Anugerah Yuka Asmara and Toshio Mitsufuji with the title "Photovoltaic Development from the New Order Era to the Reform Era in Indonesia: From a Technological Innovation System Perspective". This article discusses the phenomena of PV development between the New Order era and the Reform era using a technological innovation system (TIS) approach. This paper concludes that PV projects and technology could not be developed en masse without intervention from the government in both the New Order era and the Reform era.

We also would like to thank the authors, editors, and reviewers who have worked very hard for this edition. We hope that all the articles featured in this edition proves useful to the reader.

Jakarta, 16 July 2017

Editor-in-Chief

JOURNAL OF STI POLICY AND MANAGEMENT

Volume 2, Number 1, July 2017

LIST OF CONTENTS

LIPI

STI POLICY AND MANAGEMENT

Journal homepage: http://www.stipmjournal.org

STIPM STI Policy and Management

The Innovative Policy Options for Coastal Fisheries Economic Development: A Case of Kwandang Bay Coastal Ecosystem

Noel Taylor-Moore
Australian Volunteer International

ARTICLE INFO

Article History:
Received : 08 December 2016
Revised : 23 May 2017
Accepted : 05 July 2017
Available online : 15 July 2017

Keywords:
Policy innovation
Coastal marine ecosystem
Fisheries economic development hub
Value chains
Multi-level perspective (MLP)

ABSTRACT

Socio-environmental problems, such as climate change, pollution and habitat destruction, present serious challenges for fisheries economic development. The integration of interventions or investments within a coastal marine ecosystem, a defined spatial area, is considered important in the economic development of local communities leading to the planned outcomes of livelihoods, food security, and conservation. The coastal marine ecosystem is the provider of products and services to the local economy adjacent to the ecosystem where the benefit flows, within that area, are interconnected. The roles of science, technology and innovation (STI) are an integral part of these multi-dimensional interventions. Hence, there is a need for an integrated approach for these interventions by government and/or through donor-funded projects to enhance economic development of coastal communities. The policy framework proposed is therefore an STI perspective of the links between these intervention and investment options, based on a 'fisheries economic development hub' and discussed using the multi-level perspective (MLP). The policy innovation proposal suggests an implementation strategy of a pilot project and analyzes the selection and implications of a potential Indonesian site for the application of a Hub. The paper considers a policy innovation framework in the context of STI inputs and a multi-level perspective (MLP), selects a potential site in which fisheries economic development hub would be implemented, and performs a SWOT analysis of the selected site as a hub.

I. INTRODUCTION

The development of coastal communities, reliant on coastal marine resources, has been supported by interventions and investments by both the Indonesian government and donor-funded programs. Within these programs, the policy framework, in most cases, relies on a set of individual projects seemingly linked by the common aim towards the usual outcomes of food security, livelihoods and conservation of an ecosystem.

However, many of these projects are carried out in isolation from each other and spatially sepa-

* Corresponding Author.
E-mail: ntaylormoore@hotmail.com

http://dx.doi.org/10.14203/STIPM.2017.73

rated. For example, the projects or programs for interventions relating to i) climate change impacts on local communities based on climate change adaptation measures or ii) interventions related to effective management for sustainable fisheries; or iii) effective management of marine management areas for improving coral reef diversity, can individually occur without determining the joint impacts that all three interventions might have on food security, livelihoods, and conservation of coastal natural resources, in the same spatial area. And from a multidimensional perspective, unfortunately, the policy framework maybe integrated based on the projects of institutional strengthening, capacity building and gender actions.

As the development of coastal fisheries-based communities is multidimensional in nature, a relevant development policy framework should reflect those dimensions. For example, the integration of the multidimensional program interventions or investments, within a designated coastal marine ecosystem, is considered important for the economic development of coastal communities. The resulting impacts indicated by value-adding, along the related value chains and the socio-cultural changes related to those changes. This paper takes the socioeconomic and conservation dimensions as the key indicators of the fisheries development outcomes. Science, technology, and innovation (STI) are key inputs for these interventions and investments. But how do these key inputs relate to a policy innovation for coastal fisheries economic development?

To support the analysis, a multi-level perspective (MLP) approach (Geels, 2012; Nykvist & Whitmarsh, 2008) is used to illustrate coastal fisheries economic development as a systemic transition involving multidimensional interactions at three levels, those being *landscape*, the exogenous context of the economic, ecological and cultural conditions; *socio-technical regime*, the fisheries sector's dominant actors, institutions, practices and shared assumptions; and *niche innovations* of individual technologies and grassroots movements. Interactions between the systems underpinning fisheries economic development include scientific knowledge, R&D, technology improvements, innovation of policy and related legislation, market mechanisms, cultural norms and roles, fisheries and seafood infrastructure, coastal marine ecosystems, conservation planning, and community structures. The connectivity of science, technology, and innovation is a central factor within the integration of policy interventions.

The coastal marine ecosystem is "a community of plants, animals, and smaller organisms that live, feed, reproduce, and interact in the same area or location" (WWF, 2012) that provides products and services to the local economy, where the benefit flows within the coastal marine ecosystem area are interconnected.

The proposed policy framework (Taylor-Moore, 2014), is therefore an economic perspective that links these intervention and investment options based on a policy innovation called the '*fisheries economic development Hub*' (Hub). The paper considers a policy innovation framework in the context of STI inputs and a multi-level perspective (MLP), selects a potential site for implementing the fisheries economic development Hub, and performs a SWOT analysis of the selected site as a Hub.

II. ANALYTICAL FRAMEWORK

Fisheries economic development within a coastal marine ecosystem, for example, may be based on five keys development and growth intervention options for STI inputs. Taylor-Moore (2014, p.13) suggests options such as i) *infrastructure interventions* (e.g. fish landing centers, wharfs and service facilities, service roads, service supply technologies, waste management); ii) *supply chain interventions* (e.g. cold storage, ice production, processing, product innovation, export certification, logistics, business management, and entrepreneurship innovations); iii) *management and regulatory interventions* (e.g. Ecosystem Approach to Fisheries Management (EAFM)-fisheries research, Marine Managed Areas (MMA)-conservation and no-go zone research, and climate change adaptation measures (CCA)-vulnerable assessments); iv) *ecosystem stressor interventions* (coastal resource management, local planning, rehabilitation), and v) *institutional strengthening and capacity building interventions*

(e.g. technology investment in government agencies, communities, and stakeholders). Each of these groups of interventions requires different investment strategies involving a range of STI inputs.

However, interventions need to be supported by an *enabling environment* (e.g. fisheries sector agencies policy, planning and financial support, certification, health and hygiene regulations, administration of the hub area, logistic operations, financial institutions, private sector and community engagement, R&D, extension services, reigning institutions, and HR). These interventions are based on lessons learned in countries such as Sri Lanka (Diffey, 2012; Taylor-Moore, 2016).

The proposed policy innovation for achieving sustainable fisheries development outcomes lies within a multidimensional context, including the key economic, social and conservation dimensions and as potential areas for STI inputs (Table 1).

The policy innovation of the fisheries economic development Hub, based on coastal marine ecosystem services, is defined for the purposes of the paper as "a geographical area, related to a defined coastal marine ecosystem, where policy innovation provide linkages for improving ecosystem biodiversity, sustainable fisheries and better food security/livelihoods through the application of integrated interventions and investments" (Taylor-Moore, 2014, p. 8). In this context, fisheries economic development includes i) a defined ecosystem; ii) coastal marine resources, capture fisheries, aquaculture farming, ecotourism; iii) fisheries management systems, ecosystem management systems, climate change adaptation management system; and iv) the fisheries infrastructure and fish supply chains.

Ecosystem Services (WWF, 2012) are benefit flows derived from a coastal marine ecosystem. These are i) products directly supplied from the ecosystem, such as fish protein and or services such as ecotourism; ii) benefits of natural processes, such as tidal flows to support cage mariculture; iii) benefits of basic ecological functions and processes that support flora and fauna; and iv) cultural services gained from human relationships with the ecosystem.

Key policy development and growth intervention options, linked to STI inputs, are also shown in Figure 1.

The Asian Development Bank (ADB, 2014, p. 70) provides a model of "how a supply chain management approach facilitates job creation, income increases, and wealth creation through prioritizing and sequencing interventions to determine and overcome weaknesses in the supply chain".

The policy innovation, providing pathways to achieving the economic development outcomes, through an integrated approach, can be illustrated as the input-output-outcome perspectives of the linkages and resulting value chains of products and services derived from the selected coastal marine ecosystem.

Tasrif (2014, p. 101) makes the case for the importance of technology in an economic system as the unseen linkage of the factors of production and service provision as "the technology element is embedded in both production factors; capital and labor".

Fig. 2 is a complex, but clear representation of what the policy innovation framework entails in relation to the need for and the impacts of science, technology, and innovation.

Table 1.
Key Sustainable Fisheries Economic Development Dimensions as Areas for Science, Technology, and Innovation Inputs

Key sustainable fisheries economic development dimensions for STI inputs		
Economic	**Social**	**Conservation**
● Improved livelihoods from alternative activities ● Appropriate infrastructure ● Consolidated fisheries value chains ● Product management	● Amenity improvement ● Social cohesion ● Educational opportunities ● Waste disposal and hygiene ● Improved food security	● Habitat rehabilitation ● Improved ecosystem biodiversity ● Climate change adaptations

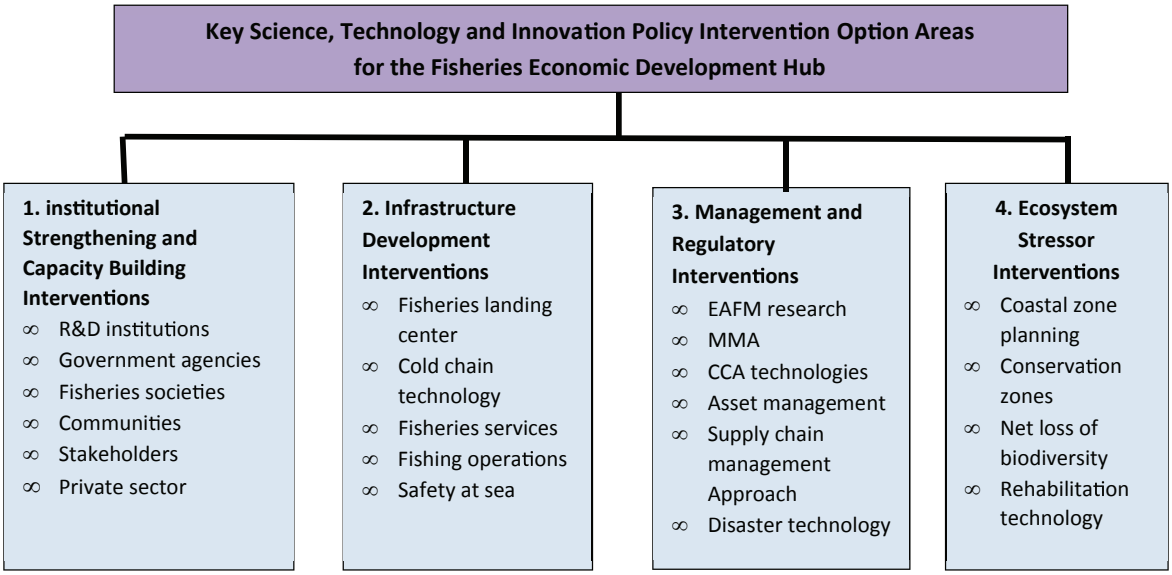

Figure 1. Potential Policy STI Intervention Options for the Fisheries Economic Development Hub

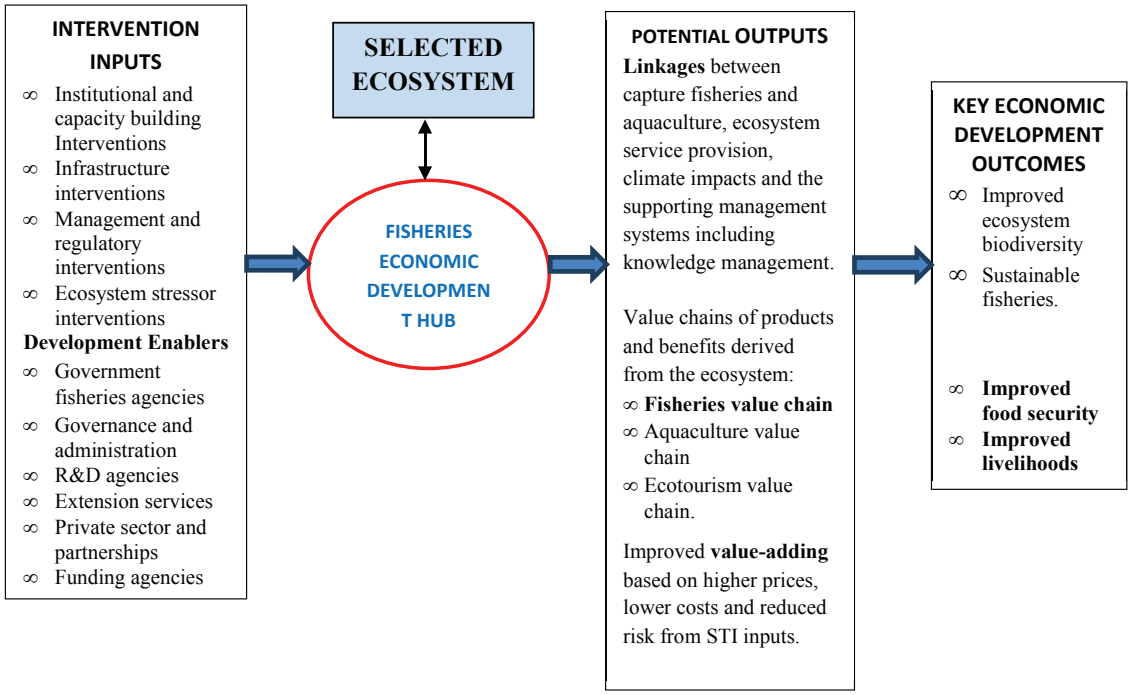

Figure 2. Fisheries Economic Development Hub as an Input-Output-Outcome System

The hub is the geographical region within which the integrated interventions lead to three key outputs; linkages between all economic processes related to ecosystem services, three important value chains, and improved value adding. The outcomes of potential improvements in food security and livelihoods are based on the hub outcomes of improved ecosystem biodiversity and sustainable fisheries.

Coastal fisheries economic development, being a significant factor to increased food security and livelihood outcomes, within the Hub, is usually based around fisheries landing centers and the fisheries value chain of capture fisheries and aquaculture (Fig. 3).

Each of the interventions/investments and development enablers (Fig. 3) has a range of potential STI inputs to support the policy innovation. For example:

1) *Management and regulatory interventions* (fish aging technology, fish biology, R&D for GPS technology, ecosystem research, climate change vulnerability research, impact analysis of closed areas);
2) *Capture fishing operations* (fish-finding technology, eco-friendly fishing gear, GPS applications, safer boats, FADs, etc.);
3) *Fish supply* (post-harvest technologies, logistics);
4) *Fish landing centers* (waste and hygiene technologies, software packages for data collection and analysis, business training, infrastructure planning); and
5) *Fisheries value chains* (processing innovations cold storage technologies, logistics, export technologies, packaging technologies, business planning).

Finally, the key questions of the policy innovation development and implementation are as follows.

Policy Area

1) What problems and issues are clearly understood and defined based on evidence?
2) What questions arise from that understanding?
3) What are the critical issues that need a solution?
4) What potential options are available based on evidence?
5) What technical issues, within the hub and for specific STI issues, relating to the policy options, been clearly defined?
6) What are the objectives, outputs, and outcomes of the policy framework?
7) What strategies are selected to achieve the chosen policy options?
8) What is the implementation and communication processes underpinning the policy?

Implementation Strategy Area

1) What district should be chosen to implement the policy?
2) Does the district have a coastal marine ecosystem that can be the basis for establishing a fisheries economic development hub (Table 1)?
3) What are the appropriate, workable interventions and/or investment options (including STI inputs) needed within the hub to address the findings of (iii)?
4) What priorities, objectives, actions and outcomes have been agreed to for the interventions within the hub?
5) What intervention and investment options are analyzed and have been agreed to?
6) What economic development enablers are present or available for the hub?
7) What indicators, for M&E purposes, reflect the changes within the hub and the agreed outcomes?
8) How can the policy innovation be implemented and managed within the chosen site?

A log-frame should be drawn up integrating the above areas.

The paper will not provide answers to all these questions, but suggests an innovative policy framework for the structure of a pilot project and the implication for STI inputs.

III. METHODOLOGY

A case study of the potential implementation of the policy innovation was undertaken in the selected province with a specific district coastal marine ecosystem. For the selected site of the hub to be successful, certain criteria–such as the characteristics of the ecosystem, key actives within the hub, and the enabling environment–were selected (Table 2).

The selection of a coastal marine ecosystem was based on a key outcome of food security. An indicator chosen from this outcome was the *kg of fish protein produced by each household* within a province sourced through either capture fisheries and/or aquaculture farming. This simple fish protein data can be used as a means to select the province where a fisheries economic development hub could be established, based on the following key data: i) production of capture fisheries product (ton/year) per household; ii) production of aquaculture product (ton/year) per household;

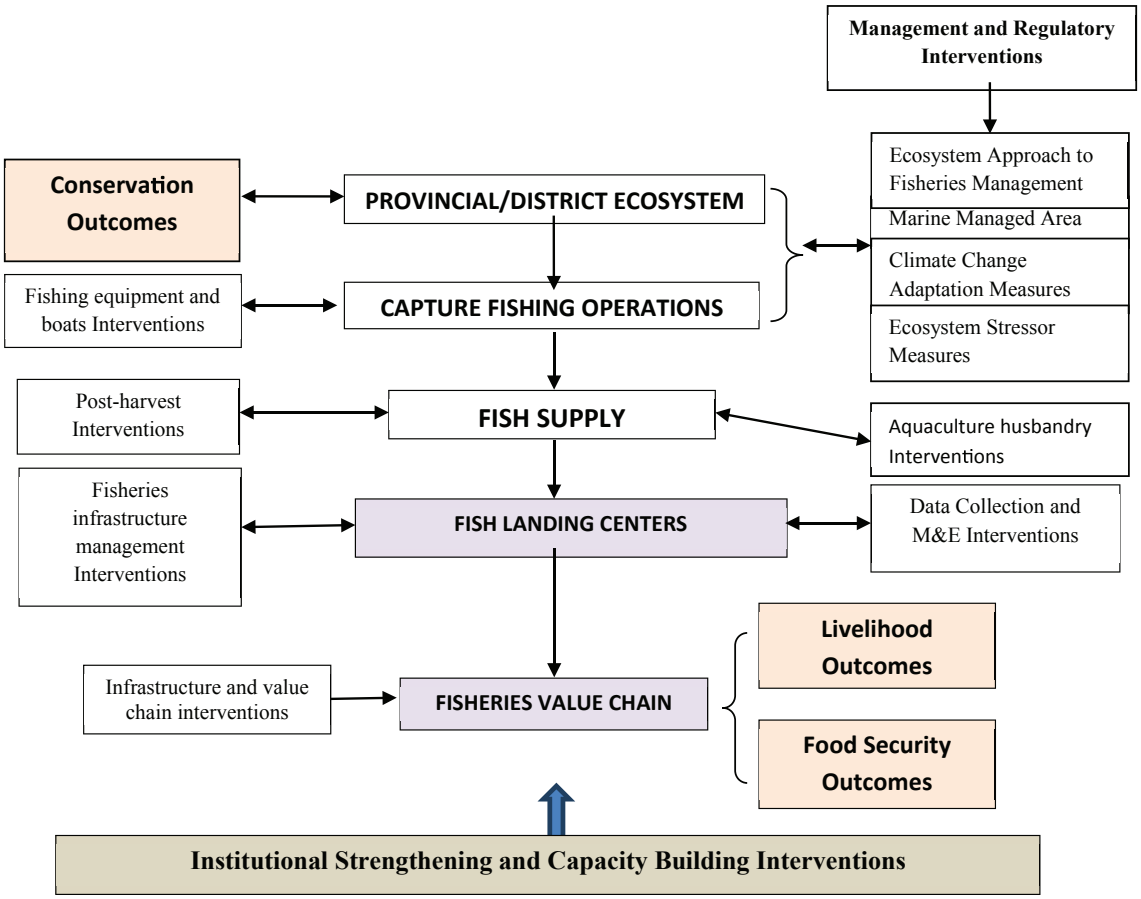

Figure 3. Policy Intervention Linkages of Coastal Fisheries Within an Ecosystem-Based Economic Development Hub

Table 2.
Key Criteria and Related Success Factors Considered for the Selection of a Coastal Marine Ecosystem for the Implementation of a Proposed Fisheries Economic Development Hub

Site selection criteria	Key Success Factors
Characteristics of ecosystem	1. Sited within a priority seascape 2. A defined ecosystem within the seascape 3. Area of ecosystem 4. Biodiversity of the ecosystem 5. MPA in place or proposed 6. Size of MPAs 7. Climate change impacts
Key activities within the hub	1. Key fisheries; 2. Diversified fisher participation; 3. Fish landing centre and services; 4. Fisheries value chain; 5. Aquaculture development; 6. Tourism development.
Enabling environment	1. Strategic planning [e.g. *Minapolitan*] 2. Agency participation 3. Administration support 4. Financial institution support 5. Logistics 6. Private sector support 7. Research availability 8. Extension support 9. Training support available 10. Community participation 11. Synergy with other programs

iii) number of households undertaking capture fisheries; and iv) the number of households undertaking aquaculture.

Using these data, findings from 15 provinces were mapped as a relationship between levels of household protein production and by focus of the source of the product (i.e. capture fisheries or aquaculture).

The criteria were based on the Indonesian production data of the Coral Triangle Initiative (CTI) as follows.

1) Proportion of total households with a focus on capture fisheries and/or aquaculture, and
2) Household protein production, compared to the CTI mean household protein production (ton/year).

Based on this relationship, each province was graded, as illustrated in Table 3.

The related fisheries value chain within the chosen site (ecosystem) was also considered in terms of two policy innovation outcomes: private and public development intervention support and the benefits that flow through the value chain. The implications of the interconnectedness of STI inputs of the policy interventions are described through a multi-level perspective, based on a SWOT analysis of the hub site.

IV. RESULTS AND DISCUSSION

A. Selection of Hub Site

The analysis of 15 potential sites for a fisheries economic development hub, shows great variation in the relationship between protein production per household and the source of protein (capture fisheries and/or aquaculture) across provinces (Table 4) and their respective geographical location (Figure 4).

Potential sites were narrowed down to Group B, based on the higher level of both protein production per household and the focus on capture fisheries. This relationship would provide a greater range of the intervention options, suggested in the policy framework, as the economic activity within the hub is likely to be broader and deeper and more easily monitored and evaluated (M&E).

For example, Gorontalo Province, allocated to Group B, had above mean protein production per household and a higher focus on production from capture fisheries rather than aquaculture

Table 3.
Grading Matrix of Criteria of Province Marine Production Focus and Mean Protein Production Per Household

Production focus of household activity	CTI mean level of fish protein production per household (ton/year)	
	Lower than mean level of production per household (ton/year)	Higher than mean level of production per household (ton/year)
Households with high focus in capture fisheries	**Group A**	**Group B**
Households with a lower focus on capture fisheries	**Group D**	**Group C**

Table 4.
Results of Province Grouping Based on the Grading Criteria Matrix (Table 2).

Production focus of household activity	CTI mean level of fish protein production per household (ton/year)	
	Lower level of production per household (ton/year)	Higher level of production per household (ton/year)
Households with high focus in capture fisheries	**Group A** North Sulawesi West Papua Papua East Java	**Group B** Cental Sulawesi **Gorontalo** Maluku
Households with low focus in capture fisheries (more aquaculture focus)	**Group D** East Kalimantan Central Kalimantan South Kalimantan West Sulawesi	**Group C** East Nusa Tenggara South Sulawesi Southeast Sulawesi North Maluku

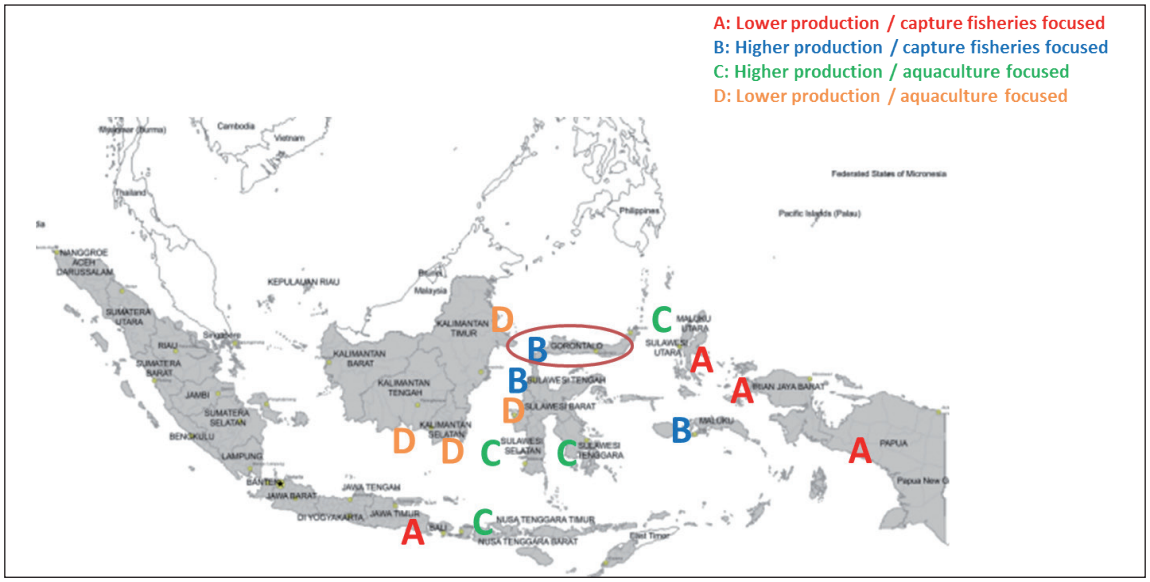

Figure 4. Map of Table 3 Findings

farming. The district of Kwandang of Gorontalo Province was selected as the hub site based on the characteristics applicable to an integrated approach to fisheries economic development (Table 2) and a site visit.

Whereas other choices, for example, could have been Papua Province (Group A) which had a high proportion of households in capture fisheries, but a low level of production per household; Central Kalimantan Province (Group D) had both a lower level of focus on capture fisheries and a low level of production per households; whilst South Sulawesi Province (Group C) had a high level of production per household with a lower focus on capture fisheries. However, Groups A, C, D may have less ability to absorb the policy innovation.

B. Kwandang Bay ecosystem in Gorontalo Province

The ecosystem chosen was Kwandang Bay, which spans about 30,000 ha within the district of Kwandang (Fig. 5). Kwandang District has a 200 km coastline and a population of 104,000. The ecosystem is diverse with sea grass meadows and coral reefs around small islands, lying in an open bay (some 20 nm across the opening) into the Sulawesi Sea. It also contains fisheries such as tuna, demersal and small pelagics taken by a variety of catching gears such as purse seine, fixed nets that move throughout the bay, bagans catching anchovies and sardines, line fishing by both traditional fishers, and outboard boats (Table 5a). Fish cages are also found in the bay. There is no obvious zoning plan. The fisheries/aquaculture sector in Gorontalo and its relative growth are shifting from capture fisheries to aquaculture, from 2009 to 2012 of 646% and with an overall growth of 100% (refer to Table 5b).

There are two fish landing centres within the hub area, the larger one managed centrally and the smaller by the district, both of which need upgrading. Key issues discussed were ice machines and fluctuating demands, wharf space, sanitation/hygiene, post-harvest technologies and training of fishers and businessmen using purse seine operations. For governance and logistic support for this potential hub site, there is only one government agency, the district fisheries department, which is also responsible for the small landing site situated just outside the bay. The need for capacity building was stressed at the provincial, district, fishers, and business meetings. There is an EAFM pilot project under an ADB project that is also a key synergy.

The Gorontalo Province Fisheries has a sound development plan for aquaculture and there are floating cages scattered around Kwandang Bay, in the deeper and cleaner waters. This is a key component of the livelihood development

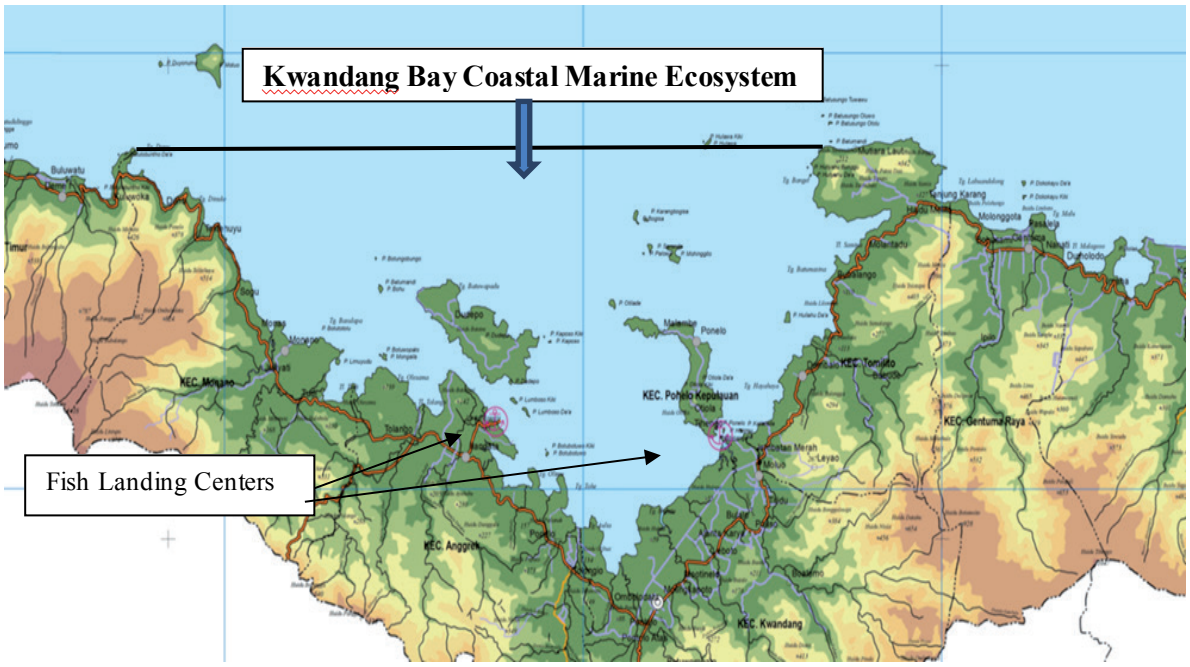

Figure 5. Kwandang Bay Coastal Marine Ecosystem Potential Hub Site

Table 5a.
Types of Fishing Boats Operating in Gorontalo Province

Type of fishing boats	Number	Percentage
Non-powered boat	1,679	20
Outboard motorboat	6,545	77
Inboard motorboat	231	3
TOTAL	8,455	100

Table 5b.
Details of Fisheries/Aquaculture Sector of Gorontalo Province

Marine Sector	Households	Production 2009 [t]	Production 2012 [t]	Change
Capture fisheries	7,779	4,186	3,567	-15%
Marine Culture	2542	48,283	95,482	+98%
Brackish water	944	2,290	3,716	+62%
Cage	156	68	136	
Floating Cage	782	1,097	8,189	+646%
TOTAL	12,203	55,924	111,450	+99%

Source: Gorontalo Provincial data for both tables. Specific data of fisheries activities is not available at district level.

of the province. The central government has the *Minapolitan* program and the district has a 2013 fisheries-based *Minapolitan* planning document. The Gorontalo Province also has a climate change strategy that is applicable to Kwandang Bay.

To illustrate further the role of potential interventions by both the private and public sectors, a more detailed fisheries value chain is presented in Table 6. The private and public sector intervention support is an area of potential STI inputs, including the measurement of the benefit flows of the policy innovation. STI inputs suggested as needed for the Kwandang Bay fisheries value chain development include the following.

1) Private sector: fishing gear R&D, GPS fishing operations technology, fisheries management science, post-harvest technology, waste management technology, cold chain technology, marketing and product innovation, funded innovation projects, and micro-financing technologies

Table 6.
Private and public support for policy-based benefit flows within the fisheries value chain of Kwandang Bay coastal ecosystem and STI implications/actions

Fisheries value chain components	Private sector policy support	Potential benefit flows	Government sector policy support
Fish operation suppliers (e.g., vessel, gears, electricity)	1) Sustainable fishing equipment at an affordable cost to fishers 2) R&D sharing 3) Knowledge sharing 4) Energy management 5) Boat building	1) New volume growth with long-term contract with fisheries economic development hub 2) Sustainable fishing practices used and fish stocks improving 3) Safety-at-sea	1) Co-financing for trained fishermen to buy sustainable fishing equipment 2) R&D for gear improvement 3) Boat- building program
Fish catch (e.g., tuna, small pelagics, and demersal fish)	1) Training to learn sustainable fishing skills 2) Provision of new equipment to replace inefficient and destructive gears 3) GPS technologies 4) Catch database development 5) New fisheries	1) Price improvement with better quality 2) Management plans leading to cohesive fisher collaboration 3) Long-term risk mitigation from overfishing 4) Fish handling improvements	1) Training fishermen to lead to sustainable fishing practices. 2) Fish management plans and certification 3) Community engagement 4) Catch record technologies
Seafood processing (e.g., potential canning, exports)	1) Value adding the lower volume growth from fish catch 2) R&D & knowledge sharing 3) Sanitation and post harvest technologies 4) R&D budgets 5) Export driven action	1) Quality assurance from certification 2) Increased employment	1) Co-develop more business- friendly policies 2) Stable tax system for the seafood sector 3) Policy and strategic planning 4) Certification for exports 5) R&D research on processing and marketing 6) Developing entrepreneurship capabilities 7) Health and hygiene certification
Seafood wholesale	1) Lower volume growth from fish catch 2) R&D & knowledge sharing 3) Ice use in markets	1) Quality assurance 2) Reduced health problems	
Seafood retailing, restaurants, and e-commerce	1) Lower volume growth from fish catch 2) R&D & knowledge sharing 3) Product branding	1) Price improvement with better quality 2) Branded product with certification 3) Quality improvement	
Logistics and storage (e.g., freezing)	1) Invest initial fixed capital for underserved logistics needs 2) Ice machines at fishing centers 3) Purpose built trucks for transporting product	Price premium to offer a fresher seafood delivery or storage solution	
Advertising and marketing support	1) Brand sustainable fishing products 2) Ocean-to-plate marketing 3) 'Fresh is best' 4) Clean-green products	1) Better public image 2) High- end sales	
Financial access support	Microfinance for equipment purchase with high credit risk exposure	New market access of new customer pool with growth potential	Co-develop financing program for trained fishermen

Note: Nested within the above potential interventions (Table 6) are the interconnectedness of STI inputs along the value chain which is connected to the Gorontalo provincial and Indonesian national value chains so these potential STI inputs within the Kwandang Bay Hub have flow-on effects to the larger economic system.

2) Public sector: R&D institutions supporting local community fisheries, policy innovation for local area management of fisheries, training of fishers in the use of fishing operation technologies, R&D institutions providing fisheries science to support fish management plans, and business management training for use of technologies relevant to local communities.

It should be noted that the level of sophistication of the STI inputs relates to the development level required and the developmental capabilities of the actors within the hub.

C. Policy implications for Kwandang Bay coastal marine ecosystem as a development hub

During the site visit meetings with fishermen, business representatives, processors, and government officials, data were collected related to the policy innovation. The SWOT analysis (Table 7) summarizes the findings of the potential of the fisheries economic development hub policy innovation being piloted within the Kwandang Bay coastal marine ecosystem.

Aminullah, Fizzanty, Indraprahasta, & Asmara (2016) examined the technological capabilities and entrepreneurship of Indonesian processing companies, with conclusion supporting the found weaknesses and potential opportunities of value-adding of fish within the hub.

Key findings of the SWOT analysis are as follows.

1) Kwandang Bay, being a beautiful bay opening into the Sulawesi Sea with deep and clean marine waters, is essential for the supply of a clean-green ecosystem seafood products and services for tourism;
2) The shift towards higher demand for mariculture products is supported by the required Kwandang District government's aquaculture development strategy;
3) It is a diverse fishery that lacks in management plans or development strategies;
4) Fish landing centers are inadequate, requiring upgrading with regard to sanitation and hygiene issues;
5) There is no zoning within the bay and therefore there is a need for marine management areas to be developed and implemented, supported by ecotourism and other beneficiaries of the bay's ecosystem services;
6) The tuna fishery, being based on the juvenile skipjack tuna, may well have overfishing problems within the waters of the Sulawesi Sea and other skipjack fisheries;
7) There is potential for community participatory processes to support investment and interventions; and

Table 7.
SWOT Analysis of Kwandang Bay Coastal Marine Ecosystem as a Potential Hub Site

Strengths	Weaknesses
1) Diverse ecosystem/open bay	1) Energy management
2) One administration	2) Limited cold chain
3) Minapolitan	3) Inadequate fish landing center sanitation/hygiene
4) 2 functioning fish landing sites	4) Limited private investment
5) Aquaculture development plan	5) Limited government funding
6) 2013 development plan	6) Limited HR capacity development
7) Gorontalo Province climate change strategy	7) Lack of fisheries plans
8) Small and large pelagic fishery	8) No zoning within the bay
9) Development projects in the area	9) Overfishing of key species
Opportunities	**Threats**
1) Reduced overfishing via alternative livelihoods	1) Tuna fishery based on juvenile skipjack tuna
2) Ecotourism	2) Linkages too complex to manage
3) Clean-green products	3) Private sector not willing to invest
4) Processing of selected species	4) Government investment unlikely
5) Capacity building using Manado training center	5) Limited community engagement in development
6) Post-harvest/new products	6) Marine management areas poorly funded and managed.
7) EAFM/CCA/MMA linkage	7) Business management not implemented
8) Posible seaweed industry development	8) Lock-in mechanisms hamper changes

Table 8.
Potential Transitions of Coastal Fisheries Economic Development through Policy Innovation Interventions within the Kwandang Hub

Potential MLP Level Changes		Key Potential Policy Innovation Interventions
Socio-technical landscape (changes impacting on the fisheries economic development within the hub)	1)	Emerging climate change impacts on the coastal ecosystem internalised within Indonesian society.
	2)	Political resource reallocation to fisheries development under new government policies
	3)	Export-driven planning
	4)	World's best economic development practices implemented
	5)	Changing societal beliefs through socialization
Socio-technical regime (transitions of fisheries economic development within the hub)	1)	Fisheries within the hub under agreed management plans
	2)	Aquaculture within the hub under agreed management plans
	3)	Community/stakeholder participatory processes agreed to
	4)	R&D application at the community levy
	5)	Fisheries and community infrastructure funded
	6)	Rules, norms etc. at collective level socialized and agreed to
	7)	Compliance frameworks enhanced and adhered to
	8)	Regulation and legislation based on negations of stakeholders
	9)	Livelihood alternatives developed to reduce fishing effort
	10)	Lock-in mechanisms reduced by private and public investment
Niche innovations impacting on the socio-technical regime (application of new technology and processes on fisheries economic development)	1)	Policy of integrated intervention from vision of new approaches to community fisheries development
	2)	M&E technologies developed
	3)	New science of ecosystem analysis developed
	4)	Compliance technologies developed
	5)	Multi-dimensional learning approaches
	6)	Knowledge management methodologies

8) There is limited private and public investment available to develop the required infrastructure and human resource capabilities to manage fisheries-related activities within the hub.

Considering the findings of the SWOT analysis, the implications for policy innovations within the Kwandang Hub are summarized through an MLP framework (Table 8). The improvements within the hub are considered as transitions within the regime–in other words, the fisheries sector and its related activities within the Kwandang Hub have undergone changes as a result of the potential STI supported interventions of the policy innovation

V. CONCLUSION

The policy framework proposed is an example of a multi-dimensional perspective of the connections between potential intervention and investment options, supported by STI inputs, based on the concept of a fisheries economic development hub.

The policy innovation proposal was considered by selecting a potential pilot site for the implementation strategy: a coastal marine ecosystem. An analysis of 15 potential provinces was based on the relationship between fish protein produced by village households and the source of that protein (a capture fishing and/or aquaculture farming focus). Results showed great variation in the relationship between protein production per household and the source of protein across the 15 provinces. Three provinces had the characteristics of a higher level of protein production and a higher level focus on capture fisheries (Central Sulawesi, Gorontalo, and Maluku). Following a site visit to the Gorontalo Province for background information and discussion with government officials, industry, and local fishers, Kwandang Bay was selected as the potential site.

A SWOT analysis of the Kwandang Bay ecosystem, as a potential hub for interventions and investments in the fisheries sector, showed that overall, currently, fisheries economic development within the Kwandang Hub is essentially weak but has the potential for improved food

security and livelihoods through an integrated intervention policy, implemented and supported by STI inputs, within the Hub.

Findings from the SWOT analysis of the Kwandang Bay ecosystem as a hub were discussed using a multi-level perspective (MLP), showing that the transitions of fisheries economic development, stimulated by the policy innovation, can be described in terms of the interconnectedness of the changes at the landscape, regime and niche level, and the potential impacts flowing from STI inputs.

REFERENCES

Asian Development Bank (ADB). (2014). *Myanmar: Unlocking the potential country – Diagnostic study*. Manilla: ADB

Aminullah, E., Fizzanty, T., Indraprahasta, G. S., & Asmara, I. J. (2016). Technological capability upgrading and entrepreneurship: Case study of selected Indonesian fish processing companies. *STI Policy and Management Journal, 1*(1), 41–57. (http://dx.doi.org/10.14203/STIPM.2016.34)

CTI Interim-Regional Secretariat. (2013). Summary report: Coral triangle initiative on coral reefs, fisheries and food security. *2nd Regional Priorities workshop*, Manado, Indonesia.

Diffey, S. (2012). *Developing fish landing centers: Experiences and lessons from Sri Lanka*. Geneva: UNFAO.

Geels, F. W. (2012). A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. *Journal of Transport Geography*, *24*, 471–482. (https://doi.org/10.1016/j.jtrangeo.2012.01.021).

Nykvist, B., & Whitmarsh, L. (2008). A multi-level analysis of sustainable mobility transitions: Niche development in the UK and Sweden. *Technological forecasting and social change, 75*(9), 1373–1387. (https://doi.org/10.1016/j.techfore.2008.05.006).

Tasrif, M. (2014). The role of technology in Indonesian economy: A system-dynamic model. *Journal of S & T Policy & R & D Management, 12*(2), 89–114.

Taylor-Moore, N. G. (2014). *Sustainable financing, projects and concepts: Application of the fisheries economic development hub concept to a sustainable finance-based pilot project*. TA-7813 REG. Manilla: Asian Development Bank.

Taylor-Moore, N. G. (2016a). *Introduction of a village-based freshwater fisheries co-management approach for (Myanmar) open waters: Policy advisory notes*. FAO project GCP/MYA/010/ITA, Myanmar.

Taylor-Moore, N. G., Romalli, G., Lwin, M. M. & Oo, A. H. (2016b). *Implementation of a village-based freshwater fisheries co-management approach for (Myanmar) open waters: Field Guide*. FAO project GCP/MYA/010/ITA, Myanmar.

World Fish Center. (2013). *Community-based marine resource management in Solomon Islands: A facilitator's guide*.

WWF. (2012). *Report: Ecological footprint and investment in natural capital in Asia and the Pacific.*