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Australian Centre for International Agricultural Research

Final report

Small research and development activity

project

Assessing mariculture market constraints and potential in South-East Sulawesi: stakeholder engagement and situation analysis

project number SMAR/2007/225

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Contents

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2 Executive summary

2.1 Background

The island of Sulawesi (38,139 km2) with a coastal area of 114,879 km2 and a coast line of 1,740 km is recognised by the government of Indonesia as a major area for development of mariculture. Within Sulawesi, one of the least developed areas is South East Sulawesi Province.

SE Sulawesi and the associated islands have many accessible and well sheltered bays and inlets with abundant natural resources, which provide suitable sites and good water quality for mariculture. Resident coastal communities are eager to increase their quality of life through adoption and development of commercial production systems for various products, including grouper, seaweed, lobster, abalone, pearl oyster and sea cucumber.

Fishery related activities are of considerable importance to this region and are currently estimated to account for about 12 % of the annual GDP, to which mariculture contributes approximately 3-4 %. In 2007, aquaculture production in the Province reached 153,160 t, valued at approximately 1000 billion IndRp, with a total of 115,483 households and 160,140 persons involved in the sector. Most production activity is centred around the islands of Buton and Muna, and in the outer Kendari Bay area, near Kendari, the major population and commercial centre of the Province.

Major production to date (> 85%) has been primarily centred around farming of red seaweed, largely in response to increasing global market demand for raw materials, but a variety of other higher value products are presently being produced for local and export seafood markets in Sulawesi, Indonesia and the broader Asian region.

Although the legislative and regulatory framework, designed in part to facilitate development of mariculture in Indonesia, has been in place since the mid 1980s-early 1990s, it is apparent that most development has taken place within the last 5-7 years. For the most part, development to date appears to have been mostly opportunistic, somewhat ad hoc and fragmented, with little strategic industry or market focus. The consequence is that much latent potential remains untapped, with limited opportunity being realised for expansion, diversification and increased profitability; this at a time when the mariculture sector throughout the region faces major challenges from, among other things, climate change, market globalisation, the global economic crisis and rapidly changing consumer preferences for higher value, quality assured seafood products for human consumption.

2.2 Present Study

Mariculture and fisheries development is often seen as an important strategy to contribute to poverty alleviation of rural coastal communities. The Government of Indonesia, having recognised this fact, is in the process of initiating development activities in partnership with the Australian Government through the ‘Smallholder Agribusiness Development Initiative’ (SADI). The purpose of this initiative is to reduce poverty and improve livelihoods for smallholders in eastern Indonesia.

The Australian Centre for International Agricultural Research (ACIAR) coordinates the ‘Support for Market Driven Adaptive Research’ (SMAR) sub-program of SADI. A major priority identified as part of the initial SMAR planning and prioritisation process was the development of the mariculture industry, particularly for various high value species in SE Sulawesi. It was further recognised that ‘through chain’ constraints were limiting commercial growth of the industry sector and economic development opportunities for the region. Adopting a more market-driven approach was therefore seen as a pre-requisite to

realising untapped potential of the mariculture industry in SE Sulawesi, with the ultimate flow of benefits directed towards local, smallholder producers (fishers and fish farmers).

The purpose of this project therefore is to develop an effective stakeholder group that is able to support the development of a more agribusiness, market driven approach to industry development of the smallholder mariculture sector in SE Sulawesi. Such an approach to market chain development is expected to benefit smallholders in the context of increased opportunity for more equitable, 'through chain' sharing of the economic value (i.e. 'value chain' agribusiness approach) of mariculture production in SE Sulawesi. The specific project objectives were:

1. To facilitate local leadership and support for mariculture industry development through establishment of a functional stakeholder network and strategic implementation framework.

2. To identify opportunities to adopt a more agribusiness, market driven approach to industry development of the smallholder mariculture market sector in SE Sulawesi.

3. In close consultation with the stakeholder network, prepare an industry development strategy.

The strategy used to deliver project outcomes against the stated objectives was to focus on establishing an initial framework for market-driven development, with an emphasis on characterisation of all components of the supply chain, from production through to post-harvest stages and associated distribution networks and market destinations. This involved initial stakeholder engagement, situation/needs analysis, knowledge management, strategic planning and capacity building, and addressing associated technical, market, communication and logistical constraints.

2.3 Conclusions and Recommendations

Given the latent potential of the industry in SE Sulawesi, it is clear that the province in general, and smallholders in particular, would gain considerable benefit to social and economic wellbeing through promoting selected market development opportunities and addressing associated key risks. Under the circumstances, the preferred approach is to 'bundle' the development and risk response into a pilot project designed to undertake a package of related activities on a pilot, commercial scale. Such a pilot project would develop, evaluate and demonstrate several village-based case studies designed to facilitate through chain practice change. According to the proposed industry development strategy, this would progress selected industry sectors in the first instance from the present Stage 1, semi-functional supply chain, to Stage II, functional market chain over a 3-5 year period. Features of the case studies would be 1) the identification of designated chain champions and formation of village-based farmer association networks, 2) formal engagement of new entrants to partner and coinvest with existing chain participants to offset and underwrite costs going forward, and 3) development and implementation of Better Management Practices (BMPs) by industry as a means to facilitate improved productivity and market access.

To facilitate implementation of the draft industry development strategy and associated conceptual framework outlined in this report, the following key recommendations are made:

Primary:

> Undertake a regional scale, 3-5 year pilot project in SE Sulawesi to trial the development, evaluation and demonstration of selected mariculture market chain strategies and associated actions as a portfolio of specific case studies.

> The pilot project to be coordinated and implemented under the direction of a new high level mariculture task force to be established in SE Sulawesi with joint representation by key industry and government stakeholders.

Secondary:

> The case studies to be undertaken concurrently in selected regions of Kendari Bay and Buton and Muna Islands with focus on selected supply chains for key 'marquise' products including seaweed, grouper, lobster, sea cucumber, abalone and pearl oyster.

> The case studies to include:

>> Formation and implementation of village-based associations ('aquaclubs') of farmers, fishers and local traders, to be recognised by the Dinas as key industry forums for communication, training and general support.

>> Identification of chain champions within such associations and elsewhere within chains, including inter-island traders and other industry stakeholders as appropriate (e.g. NGOs, investors, consultants etc).

>> Development of a regional marketing strategy and industry investment strategy to be undertaken by appropriately qualified consultant(s) under direction of key industry and government stakeholder working group including aquaclubs, chain champions, Dinas, Haluoleo University (Unhalu) and relevant NGOs and development agencies elsewhere within the provincial government of SE Sulawesi.

>> Joint establishment by the Dinas and Unhalu. of a functional and cost-effective communications system to facilitate capacity building within aquaclubs and market intelligence for real time delivery of critical price, quantity, quality and logistical data.

>> Joint establishment of a technical advisory group within the Unhalu and the Dinas for coordination and delivery of the proposed R, D & E strategy.

>> Drafting of a management plan for mariculture in SE Sulawesi which provides an aquatic ecosystem-based IMTA framework for development; to be developed by appropriately qualified consultants under direction of and in collaboration with a key industry and government stakeholder working group including Dinas, Univ. Halu., relevant NGOs and environmental management agencies elsewhere within the provincial government of SE Sulawesi, and aquaclubs and chain champions.

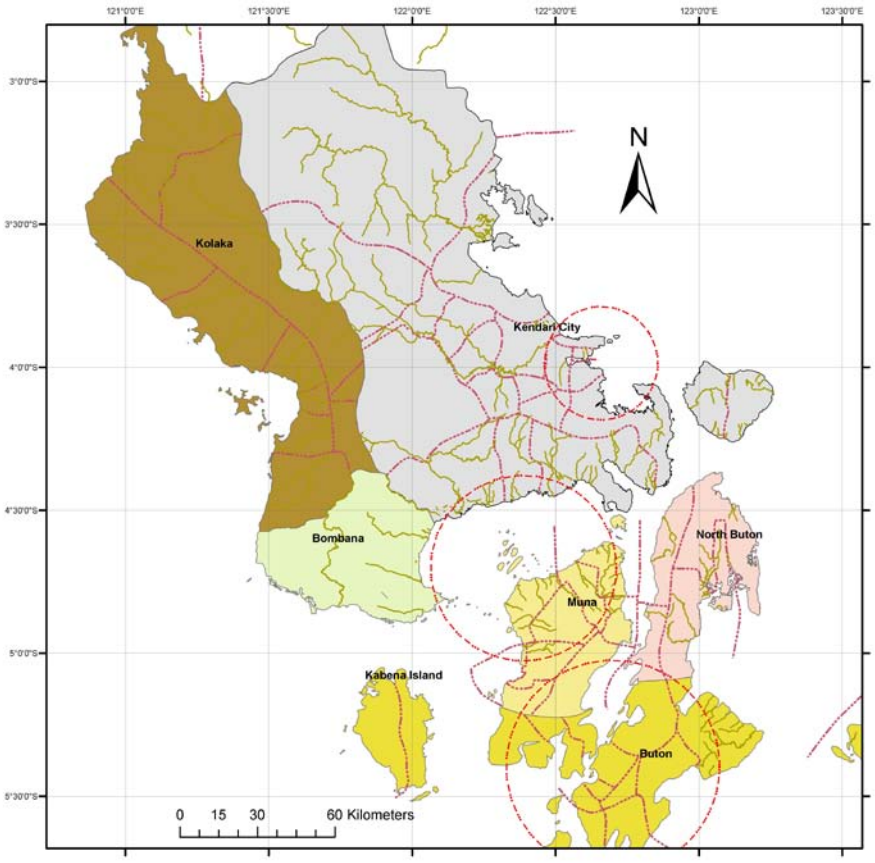
>> Development and trial demonstration of BMPs for selected industry sectors via newly established aquaclubs.

3 Introduction

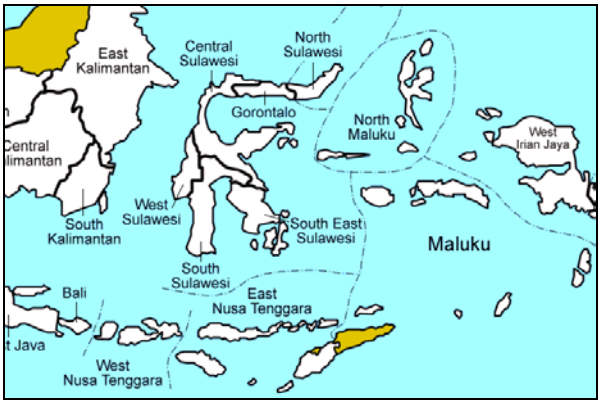
The island of Sulawesi (38,139 km2) with a coastal area of 114,879 km2 and a coast line of 1,740 km is recognised by the government of Indonesia as a major area for development of mariculture. Within Sulawesi, one of the least developed areas is SE Sulawesi Province, which consists of 12 Districts, comprising ten regencies and two towns, including Kendari which is the major population and commercial centre.

SE Sulawesi and the associated islands have many accessible and well sheltered bays and inlets with abundant natural resources, including good water quality, for mariculture. Resident coastal communities are eager to increase their quality of life through adoption and development of commercial production systems for various local products including grouper, seaweed, lobster, abalone, pearl oyster and sea cucumber.

Fishery related activities are of considerable importance to this Province, and are currently estimated to account for about 12 % of the annual GDP, to which mariculture contributes approximately 3-4 % (Aslan et al. 2008). In 2007 aquaculture production in the Province reached 153,160 t, valued at approximately 1000 billion IndRp, with a total of 115,483 households and 160,140 persons involved. Most production activity in the Province is centred around the islands of Buton and Muna, and in the outer Kendari Bay area, near Kendari. Major production to date (> 85%) has been primarily centred around farming of red seaweed, largely in response to increasing global market demand for raw materials, but a variety of other higher value products are presently being produced for local and export seafood markets in Sulawesi, Indonesia and the broader Asian region.



SE Sulawesi, showing project study areas



Location of SE Sulawesi within the Indonesian archipelago

Although the legislative and regulatory framework designed in part to facilitate development of mariculture in Indonesia has been in place since the mid 1980s-early 1990s (ICMFSER 2009), it is apparent that most development has taken place within the last 5-7 years (Dinas Perikanan 2009). In order to encourage mariculture, for export as well as for increasing domestic consumption of seafood, the 'Aquaculture and Fisheries Vitalisation Initiative for East Indonesia' of the Government of Indonesia (GOI) is being implemented at the provincial level through the Dinas. Under this initiative, aquaculture products including shrimp, lobster, groupers, seaweed and sea cucumber have been targeted. The revitalisation initiative essentially consists of providing soft loans to small-scale farmers formed into groups of 5-10 individuals and provision of training, and aims to bring about institutional (farmer groups) empowerment. The average loan provided is in the order of Rp 5-6 million, and the farmers are expected to invest these funds in seed, netting and feed procurement, and improving cage infrastructure. For SE Sulawesi, Rp 1 billion has been made available by the GOI in 2008 for investment in 12 districts/towns throughout the province.

Apart from the GOI initiative, for the most part development to date appears to have been mostly opportunistic, somewhat ad hoc and fragmented, with little strategic industry or market focus. The consequence is that much latent potential remains untapped, with limited opportunity being realised for expansion, diversification and increased profitability; this at a time when the mariculture sector throughout the region faces major challenges from among other things, climate change, market globalisation, the global economic crisis and rapidly changing consumer preferences for higher value, quality assured seafood products for human consumption.

3.1 Support for Market Driven Adaptive Research (SMAR)

Mariculture and fisheries development is often seen as an important strategy to contribute to poverty alleviation of rural coastal communities. The Government of Indonesia, having recognised this fact, is in the process of initiating development activities in partnership with the Australian Government through the 'Smallholder Agribusiness Development Initiative' (SADI). The purpose of this initiative is to reduce poverty and improve livelihoods for smallholders in eastern Indonesia.

The Australian Centre for International Agricultural Research (ACIAR).coordinates the 'Support for Market Driven Adaptive Research' (SMAR[1]) sub-program of SADI. A major priority identified as part of the initial SMAR planning and prioritisation process was the

[1] *The purpose of SMAR is to develop strengthened, province-based agricultural R&D capacity that is market and client-driven and effectively transferring knowledge between stakeholders.*

development of the mariculture industry, particularly for various high value species in SE Sulawesi. It was further recognised that 'through chain' constraints were limiting commercial growth of the industry sector and economic development opportunities for the region. Adopting a more market-driven approach was therefore seen as a pre-requisite to realising untapped potential of the mariculture industry in SE Sulawesi, with the ultimate flow of benefits directed towards local, smallholder producers (fishers and fish farmers).

For these constraints to be addressed, the functionality of existing mariculture supply chains must be enhanced to establish a more efficient and effective market chain, complete with streamlined and fully integrated production, post-harvest and market components. To achieve a functional market chain in turn requires investment in technical and marketing capacity, cost-effective networks and communication systems, infrastructure and a supportive institutional framework. Further, the natural resource base upon which mariculture industry production relies, needs to be sustainably managed to optimise long-term benefits.

Critically, for the success of the development of this industry, there is a need for:

1) a better understanding of the supply/market chain for selected mariculture products from South East Sulawesi;

2) an understanding of what constraints will need to be overcome within the supply chain to successfully link the market with smallholder producers, and

3) consideration of the different supply/market chain strategies that could be implemented to gain increased competitiveness in the market place, with particular reference to post-harvest/post-farm gate options.

This rationale is based upon the understanding that it is not production systems that will be competitive in the global marketplace, rather, competitive industries will be based on the establishment of efficient and effective 'market chains' that will be able to penetrate and maintain domestic and export market access.

3.2 The present study

The purpose of this project therefore is to develop an effective stakeholder group that is able to support the development of a more agribusiness, market driven approach to industry development of the smallholder mariculture sector in SE Sulawesi. Such an approach to market chain development is expected to benefit smallholders in the context of increased opportunity for more equitable, 'through chain' sharing of the economic value (i.e. 'value chain' agribusiness approach) of mariculture production in SE Sulawesi.

The project was commissioned in January, 2008 for a 14 month period. The project team is lead by Fisheries Victoria, Department of Primary Industries Victoria (DPIV), Australia, and involves collaboration with:

- the Faculty of Fisheries and Marine Science, Haluoleo University (Unhalu.)
- Dinas Kelautan dan Perikanan (Fisheries Department), Kendari, SE Sulawesi Province, Indonesia
- the Network of Aquaculture Centres in Asia-Pacific (NACA), Bangkok, Thailand
- the Indonesian Centre for Marine & Fisheries Socio-Economic Research (ICMFSER), Jakarta, Indonesia.

4 Objectives

1. To facilitate local leadership and support for mariculture industry development through establishment of a functional stakeholder network and strategic implementation framework.

2. To identify opportunities to adopt a more agribusiness, market driven approach to industry development of the smallholder mariculture market sector in SE Sulawesi.

3. In close consultation with the stakeholder network, prepare an industry development strategy.

5 Methodology

The key methods utilised to deliver this project were:

a) Identification, establishment and formal engagement of key stakeholder network, including smallholder producers, other market chain participants (collectors/ middlemen/ traders/ processors/ exporters), investors/entrepreneurs, relevant government and tertiary institutions in SE Sulawesi and other provinces/regions (Sulawesi/Eastern Indonesia/SE Asia/Asia-Pacific);

b) Development and commissioning of a communication plan to facilitate stakeholder engagement with emphasis on routine collation and delivery of market chain information in user-friendly format by local project partners; to include development of reliable, robust and cost-effective methods of data collection and dissemination to build market chain knowledge base;

c) Characterisation and assessment of smallholder mariculture sector structure/ status (situation analysis) and associated market chain issues, opportunities and constraints (needs analysis) in SE Sulawesi, with emphasis on both post-harvest capability (e.g. market strategies, value-adding) and production input issues (incl. availability of seedstock and feeds where appropriate);

d) Undertaking strategic planning analysis to develop and identify market chain models and options for industry development designed to build 'through chain' capacity, facilitate practice change consistent with delivery of SMAR initiative outcomes across Eastern Indonesia, achieve increased competitiveness within domestic and export markets and overall sustainable mariculture industry development in SE Sulawesi.

The strategy used to deliver project outcomes against the stated objectives was to focus on establishing an initial framework for market-driven development, with an emphasis on the post-harvest/post-farmgate component of the supply chain. This involved initial stakeholder engagement, situation/needs analysis, knowledge management, strategic planning and capacity building, and addressing associated technical, market, communication and logistical constraints.

This project is the first step in a possible multi-staged process, and was specifically designed to enable a logical and measured analysis of the situation, and preparation of an action agenda designed to underpin strategic and prioritised planning for future development by key stakeholders.

Achievements against activities and outputs/milestones Enter text

6 Achievements against activities and outputs/milestones

Objective 1: To facilitate local leadership and support for mariculture industry development through establishment of a functional stakeholder network and strategic implementation framework

no.	activity	outputs/ milestones	completion date	comments
1.1	Project visit to Kendari (Jan. '08), incl. project inception workshop, site inspections, stakeholder consultation and preliminary mapping of market chain	Draft project work plan for local partners Prelim. Market Chain (post-harvest) report	Jan '08 June '08	Local partners: University of Haluoleo, Kendari (Unhalu.), Dinas Perikanan, Kendari (Dinas) and Indonesian Centre for Marine and Fisheries Socio-Economic Research, Jakarta (ICMFSER) Market chain report ('Seafood Market Supply Chain, SE Sulawesi') prepared by Morelink Consultants (emphasis on post-harvest sector)
1.2	Establish local project team and TOR for project, incl. development of work plans and consultative network	Amended project work plan, incl. design and drafting of task specific briefs for proposed market chain survey	Feb - July '08	Back-office activities incl. consultation between DPI, ACIAR SMAR (Makassar) and local project partners, and exchange of draft briefs/agreements for agreed activities as per draft work plan
1.3	Project visit to Kendari (Aug. '08), workshop and finalisation of project steering committee and work plans	Final project work plan for local partners Project 'Technote'	Aug. '08 Oct. '08	Project visit by Australian (NACA) team members on behalf of DPI, incl. further field visits and stakeholder consultation The project 'Technote' ('Mariculture Development Opportunities in SE Sulawesi, Indonesia') published in the NACA magazine (Asian Aquaculture Asia, Vol. 13, No. 4, Oct-Dec 2008)
1.4	Project visits to Kendari and Makassar, project planning with local project partners, and training needs analysis and implementation	Training of local project team for market chain survey, and commission of survey Progress reporting and review of prelim. survey results	July '08 Nov. '08	Activity undertaken in Kendari by local project team members incl. Unhalu and ICMFSER; survey commissioned July/Aug '08 Project visit by PL, incl. activities in Makassar (industry consultation) and Kendari (industry consultation and review of survey results); survey reporting provided by Unhalu and reviewed by PL

PC = partner country, A = Australia

Objective 2: To identifyopportunities to adopt a more agribuisness, market driven approach to industry development of the smallholder mariculture sector in SE Sulawesi

no.	activity	outputs/ milestones	completion date	comments
2.1	Undertake market chain analysis, stakeholder needs and industry network feasibility analysis, and institutional framework analysis	Mariculture market chain survey report	June '09	Survey report ('Mapping Survey, Situation Analysis and Characterisation of Mariculture Supply Chain in SE Sulawesi') completed by Univ. Halu, ICMFER, NACA and DPI.
		Farmer network feasibility analysis report	June '09	Report ('Analysis of Mariculture Producer Networks in SE Sulawesi, Indonesia') completed by Dinas Perikanan.
		Report on institutional framework	June '09	Report ('Institutional Framework for Fisheries and Aquaculture Development in SE Sulawesi, Indonesia') completed by ICMFER
2.2	Review of progress/draft reports and undertake additional stakeholder consultation, market chain mapping and capability analysis	Amended draft reports as per activity 2.1	Nov. '08 - Apr. '09	Combination of project visits to Kendari (Nov. '08 and April '09) and back-office activities by PL, in consultation with local project team members in Indonesia and NACA

PC = partner country, A = Australia

Objective 3: Prepare an industry development strategy that will benefit smallholders in the context of increased opportunity for more equitable, 'through chain' sharing of the economic value of mariculture production in SE Sulawesi

no.	activity	outputs/ milestones	completion date	comments
3.1	Prepare discussion paper summarising project findings	Collective outputs from reports listed under Activity No. 1.1, 1.3 and 2.1	As per Activity No. 1.1, 1.3 and 2.1	Stand-alone Discussion Paper was not produced, rather a portfolio of reports/publications was produced to collectively address Milestone #2
3.2	Undertake project visit and convene strategic planning workshop for stakeholder engagement and input to Industry Development Strategy	Draft Conceptual Framework and Strategic Industry Development Plan for Mariculture in SE Sulawesi	April '09	Project visit completed by PL and convened strategic planning workshop with local project team and stakeholders on formulation of conceptual framework and draft industry development plan.
3.3	Prepare draft Industry Development plan incl. R, D & E action plan	Draft Conceptual Framework and Strategic Industry Development Plan for Mariculture in SE Sulawesi	April-June '09	Back-office activity by PL in consultation with project team
3.4	Finalise Industry Development Plan and meet and consult with/seek feedback from local key stakeholders	Final draft Conceptual Framework and Strategic Industry Development Plan for Mariculture in SE Sulawesi Roadshow presentation/work shop of project (Final Report) findings	July '09 Nov-Dec '09 (pending)	Back-office activity by PL in consultation with project team Presentation of Final Report findings to local stakeholders in SE Sulawesi to be undertaken (expected in Nov-Dec '10) once Final Report finalised
3.5	Prepare reports for web publication	Collective outputs from reports listed under Activity No. 1.1, 1.3, 2.1 and 3.4 GIS mapping of the study area	As per Activity No. 1.1, 1.3, 2.1 and 3.4 (and pending re translations) Sept. '09 (pending)	Back-office activity by local project team. Once Final Report is accepted by ACIAR, pdf versions of relevant reports will be made available for download via project link on NACA web page (incl. Bahasa translation). Report entitled 'Mapping of Existing Mariculture Activities in South East Sulawesi' completed by Univ. Halu.
3.6	Prepare Final Report	Final Report to ACIAR incl. all supplementary reports	August '09	Back-office activity by PL in consultation with project team

PC = partner country, A = Australia

7 Key results and discussion

The key results for this project are collectively described in the key supplementary reports prepared during the project, and are summarised below.

1) Seafood Market Supply Chain - SE Sulawesi (Morelink 2008) -

The study has identified a range of opportunities and constraints affecting the growth of the SE Sulawesi seafood industry. These are summarized below.

a) Export demand for seafood is strong. Indonesia is a major producer of a wide range of seafood for export to markets in Asia, USA and EU. Seafood (live fish, lobsters, dried abalone, dried sea cucumber and seaweed) is an important part of the economy of SE Sulawesi as the waters of SE Sulawesi provide fertile ground and a large supply base for wild catch seafood and further potential for farmed seafood.

There are good opportunities to expand the practice of 'farmed' seafood as supply of 'wild catch' seafood diminishes. There is also an opportunity to introduce regional branding (based on QA standards) to promote the Kendari seafood industry. This could be done through the establishment of a local trading cooperative.

b) Fishermen are not market focused. Fishermen supply to a collector what they catch or produce rather than what the buyer wants. This leads to lower or discounted returns to the fishermen if the seafood doesn't meet specifications on size, freshness or water content.

There is a need for training of fishermen to reduce the mortality of live fish through improved husbandry practices.

c) Traders have the market power. City based traders (from Jakarta, Surabaya or Makassar) control the buying and selling (for export or domestic markets) of seafood from Kendari seafood suppliers. Fishermen from Kendari are then price takers and lack the knowledge of market requirements. In Makassar there is a major fishing cooperative (PUSKOPIN) which provides a vehicle for exchange of information and trade.

There is a need for better communication between traders and fishermen on market requirements.

d) Limited infrastructure. The Kendari port does not have reefer containers or cold storage facilities unlike the port of Makassar. There is ice making facilities in Kendari for fishermen. Also, traders in Kendari of live fish have holding tanks and packing facilities.

There is an opportunity to introduce packing facilities in fishing communities so that they can hold and pack fish for the market. This will bring the fishermen closer to the market and improve market signals which could lead to an increase in profit per kg of seafood.

e) Involve all Strategic Allies. There are a few local Government departments that provide a service role in the seafood industry in SE Sulawesi.

There is a need to involve all allies in training and market development programs, including Quarantine, the Department of Fisheries and the University.

2) Mapping Survey, Situation Analysis and Characterisation of Mariculture Supply Chain in SE Sulawesi (Unhalu et. al. 2009):

The mariculture industry in SE Sulawesi plays an important role in providing existing source of income, jobs and potential employment opportunities for rural, coastal communities, and export earnings for the local economy. SE Sulawesi has expansive areas for potential mariculture development, but also faces various constraints, such as low productivity due to use of traditional technologies, weak bargaining position for local stakeholders in terms of accessing finance and increased share of product value. In

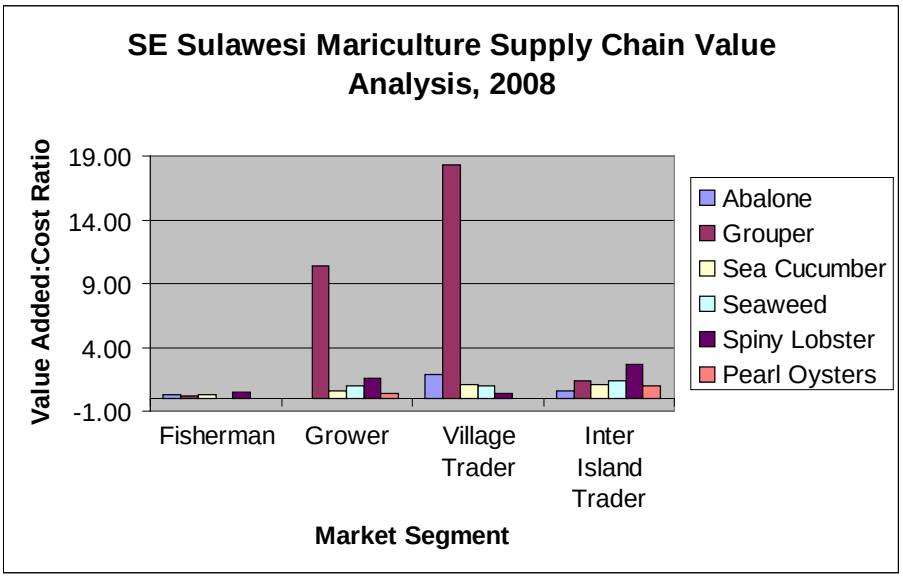
Kendari Bay in particular, the mariculture industry faces a potential environment problem due to the expansion of urban and coastal development.

In summary, the SE Sulawesi supply chain characteristics vary considerably across locations and products. Some chains are reasonably well established, relatively short and simple. Other chains are quite complex and long, and only recently established or still emerging. All supply chain stages currently play an important role. Fishers and growers are at the very start of the chain and are therefore critical to all latter stages. Village fish traders play a prominent role to collect the mariculture products in various remote locations. A relatively small number of inter-island traders strictly control the distribution and marketing of products to various local and export destinations, as well as providing financial support through loans to village fish traders. In this context, financial hardship and constraints on expansion remain a serious problem for village fish traders and by association therefore fishers and growers in all areas and for all products. Access to other, more equitable, 'external' sources of income through governmental/inter-governmental agencies and/or private, joint venture capital investment is required to alleviate this problem for producers and local village collectors

Overall, the flow of benefits in terms of share of through chain value is disproportionate, with fishers and growers typically disadvantaged by comparison to traders. In turn, local village traders typically receive proportionately less of the overall through chain value compared with inter-island traders; the latter having the only direct link into the final consumer market place. More specifically, the fishers and growers have a relatively weak bargaining position in the transaction of mariculture products in the marketplace. This imbalance needs to be addressed, perhaps through introduction of an auction-type market system and/or negotiation of forward purchase contracts in order to improve the bargaining position of various stakeholders at the production end of the supply chain.

The reliability of existing mariculture production and supply statistics for the industry is relatively low due to inconsistent and incorrect recording and reporting of production and market data, especially for live products. Unreported transhipment occurs in many places because the live fishes are sold for export directly to fishing vessels at sea where production occurs.

A summary of supply chain value analysis for the mariculture sector in SE Sulawesi, as mapped in 2008, is provided below:



Currently, SE Sulawesi is known primarily as one source of 'raw material' for the mariculture industry in Indonesia, with little emphasis on post-harvest added value. Infrastructure at production sites is limited by available technology and finance, which limits potential expansion. Mostly traditional technologies are utilised and available finance

through the existing supply chain is typically controlled by the traders. Post-harvest infrastructure at existing landing sites is limited and suitable processing, warehousing and transportation systems are needed to support the development of mariculture in SE. Sulawesi. Capacity building and institutional development at all stages is required and is considered an increasingly important investment priority in order to maintain sustainability and to increase economic viability of the SE Sulawesi mariculture industry.

3) Analysis of Mariculture Producer Networks in SE Sulawesi, Indonesia (Dinas Perikanan 2009) -

Due to its geographic location, SE Sulawesi has the advantage of having valuable natural fisheries resources, predicted to be in excess of 1,520 million tonnes sustainable annual yield. Actual fisheries production by the end of year 2007 was estimated at 200,672 tonnes, valued at (Ind.) Rp. 3,310 billion (Annual Report of Fisheries, 2007). Most fishing activities are concentrated in populated coastal areas. More than 60% of fishing gear is are still manually operated and traditional, however over exploitation of wild stock and environmental degradation due to pollution are being experienced by traditional fisheries in some areas. This has been the major problem faced by local fisherman. Also, lack of knowledge, high operational cost and low price of fish in local markets are being indentified as additional problems.

Based on existing conditions, mariculture is being encouraged by local government to enhance fisheries production and at the same time reduce environmental degradation, particularly in coral reef ecosystems, due to destructive fishing activities. Currently, mariculture is developing in almost all coastal areas of SE-Sulawesi, but medium to large farms are operated mainly in Buton, Muna and Kendari. Potential area that can be developed for mariculture is estimated to be in excess of 230,000 ha, of which an estimated 42,000-52,000 ha only has been exploited for mariculture activities already (see summary data below). Mariculture is dominated by seaweed, a staple commodity of the region, and more recently also higher value species such as groupers, pearl oysters and lobsters. Valuable capture fisheries for sea cucumber and abalone are also considered in the context of mariculture development in the present study, as both have potential to be cultured using both wild caught and hatchery-produced seed and viable, high value export markets exist. Estimated potential and actual production for key fisheries sectors in SE Sulawesi in October, 2008 (Source: Dinas Perikanan Dan Kelautan, SE Sulawesi) is:

Sector	Potential production	Actual production
Marine capture fishery	1,520,340 tonnes	286,289 tonnes
Freshwater (lakes) capture fishery	98,000 tonnes	497 tonnes
Brackishwater aquaculture	44,699 ha	14,632 ha
Freshwater aquaculture	20,850 ha	1,275 ha
Mariculture	230,170 ha	42,572 ha

Seaweed is the most cultured product in SE Sulawesi as water quality parameters and ease of culture techniques facilitate culture success of this product. Problems confronting mariculture development in SE Sulawesi include the high initial investment cost and limited availability of capital, high operational costs, limited technical knowledge and market access.

The survey findings highlight the need for and high level of support from farmers for the formation of a network of farmer groups and association. To a large extent, farmers are already organized into logical, geographically-based groupings with specific product and species focus, depending on where they are. Where groups do not already exist could readily form into groups simply on the basis of existing village and district arrangements. This also applies to fishers targeting species with potential for development as mariculture species such as abalone and sea-cucumber, as well as fishers providing trash fish for mariculture feeds and wild-caught juveniles as mariculture seedstock. All such farmers and fishers are either one or the same, where households have already diversified, or are co-located in villages so that horizontal business integration can be easily realized.

All surveyed groups have been recorded with key contacts and direct (100% preferred) contact details. All (100%) of surveyed farmer groups have indentified a requirement for skills-based training in production, marketing and other associated agribusiness disciplines. They have also completely agreed with the need for improved and expanded production and post-harvest infrastructure and the willingness to support and participate in a more functional mariculture market chain with an emphasis on both domestic and export trade.

4) Institutional Framework for Fisheries and Aquaculture Development in SE Sulawesi, Indonesia (ICMFSER 2009) -

As the lead agency at the local government level, the capacity of district MFOs to undertake the function of planning and implementation marine and fisheries development programs effectively and efficiently is limited due in part to the following issues:

The MFO, as the lead agency in mariculture development at local government level, has merged with other government institutions which have a different focus.

The capacity and capability of MFO officers to conduct marine and fisheries planning is constrained due limited skills-based training and experience relevant to marine and fisheries resources.

The allocation of budget for fisheries development programs at the provincial level creates difficulties for implementation at the district level, particularly where programs are not targeted at stakeholder needs e.g. budgets targeting infrastructure when the priority should be on technical assistance and supporting funds to offset operational costs.

Regular technical and management assistance is limited for most mariculture programs implemented at the district level, and

Most of the budget focus is on increasing the primary production of mariculture business and limited effort is put into encouraging value-adding to secondary products through quality control grading and processing of the products.

The mariculture industry in SE Sulawesi specifically needs many improvements to achieve and economically viable industrial scale. To facilitate development, priority consideration should be given to:

Pilot support for MFOs at the three main mariculture production locations in SE Sulawesi (Kendari, Buton and Muna) as part of a provincial scale case study, with the emphasis being to encourage community-based economies and demand driven policies.

Increasing the capacity provincial and district MFOs specifically relating to the management and technical support of mariculture businesses as well as for strategic planning of the sector.

At the MoMFA level, there is a need to increase funding support for the development of mariculture and fishery sector as a whole.

5) Mapping of Existing Mariculture Activities in SouthEast Sulawesi (UnHalu 2010)

The objective of this study was to map the existing status and geo-physical attributes of mariculture activities in the Province, including seed source, production and distribution of key species, practiced mariculture techniques, key water quality and other bio-physical parameters, as part of the broader ACIAR project survey designed to characterise the existing mariculture supply chain in SE Sulawesi.

It is expected that this study will provide valuable information to key mariculture sector stakeholders, including business entities and individuals, government agencies, researchers and to the fish farmers themselves in order to develop sustainable yet profitable mariculture in SE Sulawesi. This allows for a better understanding of what industry development strategies are required to enhance functionality of the supply chain and improve overall profitability and sustainability of the sector. In particular, the improvement of livelihoods and overall wellbeing of smallholder producers is an expected medium-longer term outcome of the adoption of a more agribusiness approach to development of mariculture in this Province.

Based on the results of this study, the following conclusions and recommendation are made:

>> Three big clusters of existing mariculture activities are located in Kendari, Muna and Buton areas, collectively serving as both a source of mariculture products and a market destination or transit location.

>> Most mariculture production in SE Sulawesi is based on traditional practices.

>> All surveyed locations of existing mariculture activities in SE Sulawesi show relatively optimal water quality conditions.

>> A lack of financial support, knowledge, skill, market information and institutional support has prevented farmers from enhancing their livelihoods and wellbeing through mariculture activities alone.

>> Site capacity and suitability analysis of existing or potential areas of mariculture activities and development have largely not been considered by stakeholders involved in managing coastal areas, resulting in crowded and unmanaged development with multiple overlapping economic activities in some areas.

>> Sensitive mariculture activities can be forced out from areas due to environmental and amenity impacts from other conflicting activities.

>> Locations with no land transportation (small islands) or geographically far from capital cities have longer supply chain for products, with reduced profit margins as a result.

>> Piloting of integrated ‘value-adding’ mariculture industries (e.g. raw material, processed products and ‘ready to eat’ industries) might help ease some if not all of the existing economic problems of the mariculture sector.

>> Twice annual time series of water quality measurements representing wet and dry seasons is required to depict the real condition of water quality in SE Sulawesi, for both existing and proposed areas for development.

6) Conceptual Framework and Strategic Industry Development Plan for Mariculture in SE Sulawesi (DPI et al. 2009):

An industry development strategy for the mariculture sector in SE Sulawesi will assist industry to explore concepts, identify risks and opportunities, prioritise and schedule key needs and associated tasks, set targets and goals and otherwise provide a formal vehicle to engage stakeholders, including industry, government, service providers and investors in relation to such issues as:

a) Organisation and management: Considers the requirements for key industry networks and linkages between industry participants and attraction of competent leaders ('chain champions'), producers, traders, investors and service providers.

b) Market planning and development: Refers to such issues as joint marketing and marketing alliances, distribution alliances, better integration of primary producers, processors and exporters and the development of strategic marketing plans.

c) Primary production supply, growth and profitability: Requirements to determine and implement improved production and post-harvest practices in the form of Better Management Practices.

d) Quality assurance systems: The development and implementation of appropriate 'through chain' QA/QC systems, food safety and traceability to meet market needs and expectations.

e) R, D & E and training: Requirements for market chain members to enhance productivity, profitability and sustainability through access to new technologies and to standardised training programs are issues for consideration.

f) Investment: Framework for lobbying for Government and aid program support and for attracting new capital investment for infrastructure, capacity building, market development etc.

To achieve these outcomes, the industry development strategy should have a clear vision and be based on SMART goals (Strategic Measurable Achievable Realistic Timely) goals owned and supported by key stakeholders, with an agreed work plan incorporating prioritised actions and a timetable for addressing short, medium and long term objectives and outcomes.

The industry development strategy should remain in draft format at least initially until all stakeholders are consulted and feedback provided, after which it can be finalised and implemented as a Stage I/II plan. The strategy needs to be reviewed and revised as appropriate at least every three years thereafter to ensure it remains on track to achieve stated outcomes.

A tentative vision for development of the mariculture industry in SE Sulawesi is:

" To be a significant and sustainable primary industry supporting social, economic and environmental wellbeing of coastal communities throughout the Province…."

To realise this vision, the following key development goals are proposed for initial consideration:

> High Level (long term)

>> The mariculture industry to develop through an agribusiness-based, market-driven approach

>> Smallholder, business and institutional capacity enables the realisation of industry potential and flow of through chain benefits

> Low Level (short-medium term)

>> Development is supported by producer networks and associated integrated businesses employing Better Management Practices

>> Development is supported by targeted, industry-based RD&E and skills-based training

>> Development is supported by structured investment, market development and marketing plans

These goals also implicitly indentify the broad scale practice changes that are required from industry and key stakeholders, as well as the expected knowledge, attitudes, aspirations and skills that are likely to become apparent.

Key Result Areas and associated performance indicators to determine progress in meeting these goals are yet to be determined, but may include:

> Validated production, pricing, yield and profitability data for mariculture sectors/products

> Producer association registrations, start-ups, communications, enquiries and feedback

> Compliance with and performance of agreed Better Management Practices

> Market/buyer demand, trends and specifications

> Through chain infrastructure and investment trends, registered businesses and start-ups

> Registered training courses, enrolments and qualifications

> R,D & E outputs, publications, manuals, services and IP commercialisation.

The primary 'end users' and beneficiaries of the proposed mariculture industry development strategy for SE Sulawesi include:

> Smallholder farmers, fishers and local traders

> Coastal communities

> Other chain participants

> Provincial and regional institutions (tertiary and government)

For the purposes of this study, a three staged industry development strategy is proposed, with a primary 'through chain' focus based on the following timeframes and nominal descriptors:

> Stage I - Present – Semi-Functional Supply Chain

> Stage II - next 3-5 yrs – Functional Market Chain

> Stage III - >5-10 yrs – Value Chain

The present, Stage I 'semi-functional' supply chain (Fig. 1) is so described based on the outcomes of the environmental scanning undertaken as part of this study (see also Unhalu. et. al. (2009)). The existing supply chain is established, operational and economically viable, but profitability is variable and disproportionate across sectors and probably therefore not viable in the longer term. Producers are 'price takers' rather than 'price makers', thereby subject to the vagaries of fluctuating market demand with limited ability to optimise recurrent expenditure, revenue and overall profitability. Producers typically place little premium on product quality beyond the needs of the next step in the chain. In most cases they are unaware of end consumer needs and associated market requirements, other than what is dictated by the traders. This is a disincentive for investment, expansion and diversification by the producers. Although existing practices are largely traditional and consistent throughout the Province, there is also no accepted benchmark for production techniques, product quality or environmental management. In the absence of adopting a more agribusiness approach to development, livelihood of producers remains mostly impoverished and considerable potential remains unrealised.

To break the status quo, industry development requires an investment in capacity building, production, communication/information systems and post-harvest infrastructure, resource management and a strategic market focus.

Stage II is proposed as the first step in progressing from the existing supply chain scenario to a more functional market chain over the next 3-5 years. This is seen as the immediate priority for the industry, but with an aspirational goal of subsequently developing a true 'value chain' in the longer term as Stage III (realistically, given existing circumstances, unlikely within the next 5-10 years).

A Stage II Functional Market Chain is characterised by most sectors being established on agribusiness principles of management and development, typically featuring strong, strategically-based partnerships or networks with more integrated and streamlined planning, production, trading and marketing processes. These partnerships or networks would be led and/or coordinated and managed by designated 'chain champions' and provide a platform for development, demonstration and implementation of standardised Better Management Practices (BMPs). Market information systems would be established and operational for much of the chain, allowing pricing, quality and profitability to be enhanced. This would provide the basis for a more informed, strategic expansion in overall production of existing products and diversification into new products as appropriate, together with necessary market-driven incentive for changing established practices. Higher value and quality products would begin to be differentiated in the market place with the assistance of BMPs to underpin quality control, productivity improvement and environmental management. Enhanced technical capacity and infrastructure at all stages would be under active development and expansion, as evident from combined government and private sector investment.

8 Impacts

8.1 Scientific impacts – now and in 5 years

This project has created a valuable new database which comprehensively describes in quantitative and qualitative form a suite of key parameters which effectively define the scope, scale and present status of the mariculture sector and associated supply chain for selected products within SE Sulawesi. This is the first time such a database has been formulated and effectively characterises and maps the present industry situation. To this end, this database is both valuable and unique; as such data has not previously been available.

Within five years, and assuming the proposed industry development strategy is implemented successfully, the industry should have progressed from the existing semi-functional supply chain (Stage I) to at least a more functional market chain model (Stage II). At this point, and assuming further data collection to enhance the database and to expand the temporal scale of the data (if not the spatial scale) through perhaps repeat, biannual surveys, the database will enable reliable time-series monitoring and analysis of key industry management and development metrics for purposes of facilitating evidential-based, sustainable management and development of mariculture in SE Sulawesi.

8.2 Capacity impacts – now and in 5 years

The major capacity building impacts from the project have been achieved in three key areas:

The Fisheries Faculty at Unhalu has the first cohort of undergraduate students progressing through as 3rd year students at the present time (four year undergraduate course). Eight leading students were selected by the faculty as 2nd year students in 2008 to undertake the field component of the baseline socio-economic and market chain survey of the mariculture sector in SE Sulawesi as part of the project. The students were supervised jointly by the Dean of the Faculty, Dr Aslan Laode, and Mr Armen Zulham, (ICMFSER). Survey design was undertaken by the Project Team, student training by Armen Zulham and day to day support provided by staff of the Faculty. The students undertook initial data collation, summary analysis and reporting, including presentation of preliminary results at the Project's strategic planning international workshop in Kendari on April 25 2009. This seminar presentation involved English language PowerPoint seminar, together with Bahasa translation seminar notes for local workshop participants. This was the first ever English language seminar presentation by students in the 27 year history of Unhalu. This task was undertaken as an additional work load to the normal undergraduate course work, and the students were only paid a relatively small, nominal allowance for time spent, plus travel costs. Basically the students participated as a unique learning experience and a practical means to enhance various skills. The quality of the work was exceptional and the students collectively made a major contribution to the project through delivery of the field component of the survey.

It is expected this cohort of students will provide leadership to other senior undergraduate students in the Faculty as they progress towards conclusion of their graduate degree in 2010. Within the next five year period, these same students are expected to be most likely to undertake post-graduate training at various levels and/or take up science-based positions within government and/or leading industry development positions. The impacts of capacity building of this type are expected to be realised within the next five years coincident with needs and opportunities arising as industry development in the mariculture sector in SE Sulawesi progresses from Stage 1 (present; semi-functional supply chain) to Stage 2 (proposed functional market chain). Demand for science-based skills to underpin

various aspects of environmental monitoring and management planning, as well as agribusiness development and management, will be at a premium at this time.

From a broader science delivery perspective, the enhanced capacity at the Faculty level was achieved through establishment of effective collaborative networks. Specifically, the partnership established between the project team members and associated faculties (e.g. GIS) and other institutions, including Unhalu, the Dinas, ICMFSER, NACA and DPI, has collectively enhanced local capacity for science delivery, strategic project planning, management and reporting, and general communications to facilitate international engagement. Practical experience in delivering a multi-disciplinary, collaborative project such as this has focussed the attention of local stakeholders and set new benchmarks in achieving acceptable standards of project delivery governance and overall performance, including completeness, accuracy and timing of outputs. This enhanced capacity will provide a framework for developing, leading and delivering future programs in SE Sulawesi over the next five years and beyond. It also provides an effective focal point for foreign aid funded project investment and engagement by associated agencies, including national governments such as ACIAR, NGOs and inter-governmental agencies (such as NACA).

From an industry perspective, the major capacity impacts going forward, subject to adoption of relevant recommendations would be enhanced knowledge, skills, business acumen and profitability collectively realised in the formation of proposed farmer associations and development and adoption of BMPs.

8.3 Community impacts – now and in 5 years

Immediate community impacts from the delivery of this project are limited. This project is primarily a scoping study designed to identify needs and opportunities, and to establish enhanced capacity to facilitate future developments. Tangible community impacts are therefore expected to be more apparent within the next 3-5 years, subject to the recommendations for the project being actioned.

More specifically, the project has described the role that commercial mariculture presently plays in delivering significant socio-economic benefits to small-holder fishers, farmers and collectors/trader in mostly impoverished coastal communities in the Kendari, Muna and Buton regions of SE Sulawesi. The project has also clearly identified the role that marine natural resources, both biological and physical, play in supporting mariculture production in SE Sulawesi. The project has characterised the existing semi-functional market chain for mariculture in these regions, which indicates a disproportionate minority flow of benefits to small-holders, an overall lack of an agribusiness approach to farming, a lack of a strategic approach to development, and a lack of an ecosystem framework for marine resource management.

Subject to implementation of recommended actions designed to facilitate industry development and progression to Stage II (Functional Market Chain), broader community benefits are expected to commence being achieved within a five year time frame in Se Sulawesi.

In the absence of any further activity, the collective impacts on the community presently amount to an overall loss of opportunity for growth, and the risk of environmental decline within the coastal zone of SE Sulawesi where the key centres of mariculture production are located.

8.3.1 Economic impacts

Within five years, potential exists to increase overall mariculture production levels within selected key sectors, including seaweed and selected higher value products. Growth rates in production are difficult to project due to the lack of reliable data for existing production, but mean annual growth consistent with recent trends in seaweed farming are considered

reasonable as a benchmark. Overall production level increases are likely to be complemented by increases in unit pricing over time, particularly as quality control/assurance and marketing support take effect.

Production costs are likely to be moderated due to competitive pricing of labour going forward, and the natural productivity of the region. Conversely, cost pressures on inputs from introduction of new production technologies and infrastructure, the cost of certification for market access, and the vagaries of export pricing in otherwise global markets for most mariculture products, are likely to moderate returns periodically, if not progressively. On balance, given the abundance of natural advantages in SE Sulawesi, and global demand far exceeding supply for high quality mariculture produce, significant economic benefits are expected for the region if the constraints can be addressed, and opportunities realised.

8.3.2 Social impacts

Coastal communities in SE Sulawesi are mostly impoverished, with few readily apparent opportunities for sustainable economic growth and enhancement of personal well being. Mariculture is one sector where the flow of economic benefits has potential for broader knock on social impacts throughout the communities. The proposed agribusiness-based industry development strategy has a concerted focus on building cooperative networks within and between these communities in order to facilitate skills-based training, diversified, expanded and integrated farming/fishing and regional-scale marketing and branding to tap into lucrative export markets. If the existing Stage I semi-functional supply chain can be developed to Stage II functional market chain over the next five years and beyond, the knock-on social benefits to costal communities in terms of creating opportunities for employment of future generations in mariculture may be considerable in SE Sulawesi. These opportunities include directly as fishers and farmers, and indirectly in myriad support services such as logistics, processing, marketing training, administration, management and R, D&E.

8.3.3 Environmental impacts

Maintaining the integrity of the marine environment is central to the existing legislative framework that has been put in place at a national level in Indonesia. In practice, the application of this legislation at the regional level within the mariculture industry in SE Sulawesi is limited, with few apparent planning provisions based on environmental sustainability imperatives. There is little or no environmental monitoring, and exceeding environmental carrying capacity and negatively impacting natural resource assets from excessive and/or otherwise inappropriate industry development are identifiable risks at the present time, particularly in Kendari Bay.

At the present time, the expansive coastline and the low density, traditional approach to farming in most areas, including particularly in Buton and Muna, do not present major environmental threats. There is scope for substantial expansion in production within natural environmental carrying capacity limits in all areas of SE Sulawesi, but it will require adoption of an ecosystem-based management framework, such as Integrated Multi Trophic Aquaculture (IMTA). The concept of trophically balanced production inherent in IMTA is a feature of the proposed mariculture industry development strategy for SE Sulawesi proposed by this project.

8.4 Communication and dissemination activities

1. Major workshops:

> Project Inception and Planning International Workshop, Plaza Inn Hotel, Kendari, SE Sulawesi, January, 2008.

> Strategic Planning International Workshop, Plaza Inn Hotel, Kendari, SE Sulawesi, April 2009.

2. Major surveys:

Direct communications were undertaken with smallholder stakeholders in coastal villages were undertaken as part of delivery of the two key surveys undertake in this project: involving

> Completed Mapping Survey, Situation Analysis and Characterisation of Mariculture Supply Chain in SE Sulawesi during July-Dec 2008; involved completion of 147 direct interviews of individual respondents covering three regions (Kendari Bay, Buton and Muna Islands) and 'grower, fisher, local trader and inter-island trader' sectors in all aspects of the mariculture market chain in SE Sulawesi (see also Unhalu. et al. 2009, this report).

> Completed analysis of mariculture producer networks in SE Sulawesi during July-Dec 2008; involved direct interview of 47 specific/village-based producer (farmer/fisher) groups covering three regions (Kendari Bay, Buton and Muna Islands) of SE Sulawesi (see also Dinas et al. 2009, this report).

> Completed GIS mapping of existing mariculture activities in the three major producer locations of Kendari Bay, Muna and Buton islands during June-July 2009 (see also Unhalu. 2010, this report).

3. The article entitled 'Mariculture Development Opportunities in SE Sulawesi' was published in the official Network of Aquaculture Centres in Asia-Pacific (NACA) Aquaculture Asia Magazine (October-December 2008). This magazine has widespread coverage throughout the Asia-Pacific, including Indonesia and Australia, and is available via a free pdf download from the NACA website.

4. The project fact sheet entitled 'Cultivating Marine products for Market' was published by ACIAR in the ACIAR-SADI Update 2.7 (April 2009), and is available as a free pdf download on the ACIAR website.

5. A poster entitled 'Mariculture Sites and Species Cultured in SouthEast Sulawesi, Indonesia' by Univ. Halu, Dinas, ICMFSER, DPI and NACA accepted for presentation and publication in proceedings of 'Global Aquaculture Conference 2010' in Bangkok, June 2010.

6. The final ACIAR report and all supplementary reports for the project will be posted to the NACA website for further distribution as free pdf version downloads to stakeholders throughout the region. The Final Report will also be available on the ACIAR website as a free pdf version download.

9 Conclusions and recommendations

As previously stated, the major conclusions and recommendations for this project are based collectively on the findings of the various surveys and analyses undertaken and reported separately as part of this project. These conclusions and recommendations also fed into the preparation of the draft conceptual framework and industry development plan reported by DPI et al. (2009), which aimed to draw on all previous project findings for purposes of documenting key conclusions and recommendations designed to address the primary objectives of the project within an overarching and strategic context. These are summarised below.

9.1 Conclusions

Given the latent potential of the industry in SE Sulawesi, it is clear that the province in general, and smallholders in particular, would gain considerable benefit to social and economic wellbeing through promoting selected market development opportunities and addressing associated key risks. Under the circumstances, the preferred approach is to 'bundle' the development and risk response into a pilot project designed to undertake a package of related activities on a pilot, commercial scale. Such a pilot project would develop, evaluate and demonstrate several village-based case studies designed to facilitate through chain practice change. According to the proposed industry development strategy, this would progress selected industry sectors in the first instance from the present Stage 1, semi-functional supply chain, to Stage II, functional market chain over a 3-5 year period. Features of the case studies would be 1) the identification of designated chain champions and formation of village-based farmer association networks, 2) formal engagement of new entrants to partner and coinvest with existing chain participants to offset and underwrite costs going forward, and 3) development and implementation of Better Management Practices (BMPs) by industry as a means to facilitate improved productivity and market access.

An example might include partnering up with one or more existing seafood companies based in Kendari Bay that are presently focused primarily on the wild catch fishery for inputs, particularly deep water pelagic fishes. These companies, operating as chain champions, are likely to have spare storage, processing and transport capacity and access to existing export markets in which demand exceeds supply. These companies may also have more ready access to venture capital for investment in new production infrastructure and capacity building, and may be amenable to entering into forward purchase contracts to offset existing financial risks to smallholders. For smallholders to effectively engage with such partnerships, better organisational arrangements and enhanced capacity is required.

9.2 Recommendations

To facilitate implementation of the draft industry development strategy and associated conceptual framework outlined in this report, the following key recommendations are made:

Primary:

> Undertake a regional scale, 3-5 year pilot project in SE Sulawesi to trial the development, evaluation and demonstration of selected mariculture market chain strategies and associated actions as a portfolio of specific case studies

> The pilot project to be coordinated and implemented under the direction of a new high level mariculture task force to be established in SE Sulawesi with joint representation by key industry and government stakeholders.

Secondary:

> The case studies to be undertaken concurrently in selected regions of Kendari Bay and Buton and Muna Islands with focus on selected supply chains for key 'marquise' products including seaweed, grouper, lobster, sea cucumber, abalone and pearl oyster

> The case studies to include:

>> Formation and implementation of village-based associations ('aquaclubs') of farmers, fishers and local traders, to be recognised by the Dinas as key industry forums for communication, training and general support

>> Identification of chain champions within such associations and elsewhere within chains, including inter-island traders and other industry stakeholders as appropriate (e.g. NGOs, investors, consultants etc)

>> Development of a regional marketing strategy and industry investment strategy to be undertaken by appropriately qualified consultant(s) under direction of key industry and government stakeholder working group including aquaclubs, chain champions, Dinas, Unhalu and relevant NGOs and development agencies elsewhere within the provincial government of SE Sulawesi

>> Joint establishment by the Dinas and Unhalu of a functional and cost-effective communications system to facilitate capacity building within aquaclubs and market intelligence for real time delivery of critical price, quantity, quality and logistical data

>> Joint establishment of a technical advisory group within the Unhalu And the Dinas for coordination and delivery of the proposed R,D & E strategy

>> Drafting of a management plan for mariculture in SE Sulawesi which provides an aquatic ecosystem-based IMTA framework for development; to be developed by appropriately qualified consultants under direction of and in collaboration with a key industry and government stakeholder working group including Dinas, Univ. Halu., relevant NGOs and environmental management agencies elsewhere within the provincial government of SE Sulawesi, and aquaclubs and chain champions.

>> Development and trial demonstration of BMPs for selected industry sectors via newly established aquaclubs.

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INSTITUTIONAL FRAMEWORK FOR FISHERIES AND AQUACULTURE DEVELOPMENT IN SOUTH-EAST SULAWESI, INDONESIA

Indonesian Centre for Marine and Fisheries Socio-Economic Research

in association with ACIAR Project SMAR /2007/225

"Mariculture Market Chain Development in SE Sulawesi"

and Project Partners:

Fisheries Victoria, Department of Primary Industries, Victoria, Australia

June 2009

Background

Indonesia has managed marine and fisheries resources at a governmental level since the colonial era. More recently, the momentum for management of fisheries resources increased substantially after the parliament of Indonesia ratified the *United Nations Convention on the Law of the Sea (UNCLOS) 1982,* on 31 December 1985 through the Indonesia law no. 17/1985. A year after UNCLOS, the Indonesian parliament approved law no. 5/1983 on Indonesia's Economic Exclusive Zone on the sea. Two years after the UNCLOS the parliament of Indonesia approved bill no. 9/1985 on fisheries. In 1990 the Indonesia government, concerned with threats to the marine environment and the need to provide protection from degradation, produced law no. 5/1990 on ecosystems and natural resources conservation. In this context, the key regulation produced by the Indonesia parliament related to Indonesian waters is law no. 6/1996.

Since the UNCLOS, many regulations and rules related to fisheries and marine resources were developed and implemented by the Indonesia government under the direction of the Ministry of Agriculture. During the subsequent reformation era under President Abdurrahman Wahid, the Ministry of Marine and Fisheries Affairs (MoMFA) was established specifically to manage the marine and fisheries sector in Indonesia. The establishment of this ministry did not automatically reduce the authority of other ministries in relation to managing marine and fisheries resources, due to the Indonesia government view that the sea is a key territorial area for defense, but with additional values including ecosystem conservation, marine and fisheries services, tourism, mines and quarrying areas, transportation and potential natural resource areas. Many authorities on marine and fisheries areas are presently under government control, subject to various legislative and regulatory instruments including:

- Regulation No. 11/ 1967 on mines and quarrying.
- Regulation No. 8 / 1971 on Govt Oil Company (Pertamina).
- Regulation No. 1 / 1973 on the Indonesia Continental Zone.
- Regulation No. 3 / 2002 on Indonesia National Defence.
- Regulation No. 5 / 1983 on the Indonesia Economic Eclusive Zone.
- Regulation No. 5 / 1990 on natural resource conservation and ecosystem.
- Regulation No. 9 / 1990 on tourism.
- Regulation No. 21 / 1992 on sea transportation.
- Regulation No. 26 / 2007 on spatial planning.
- Regulation No. 31 / 2004 on fisheries.
- Regulation No. 32 / 2004 on local government.
- Regulation No. 27 / 2007 on Coastal Zone and Small Island management.
- And many other regulation related to marine and fisheries resources used.

Fisheries Planning and Budget

Since the reformation era in Indonesia, the MoMFA has had authority to manage and exploit the country's marine and fisheries resources for societal prosperity. At the national level, every year the ministry proposes an approval of allocation of the budget (called APBN) to the Indonesia parliament based on the planning of the marine and fisheries development program.

More specifically, this planning is based on the Indonesia Medium Plan Program called ("*RPJM" Rencana Pembangunan Jangka Menengah*). Of recent times, the amount of budget allocated to the marine and fisheries sector by the parliement throught the RPJM is estimated at about ±Rp. 3-4 trillion total each year for 33 provinces of Indonesia. This budget is considered quite limited considering the spatial scale and location of Indonesia's marine and fisheries resources. The budget is allocated to nine echelons, such as Directorate General of Aquaculture, Directorate General of Fishing, Directorate General of Surveillance and Monitoring of Marine and Fisheries Resources, Secretariat General and the Research Agency of MoMFA. The budget allocated to the MoMFA is primarily to cover salary costs for staff, spending for infrastructure in various fisheries areas, other programs to support the development of marine and fisheries resources, as well as a small amount allocated to research.

Presently, only two Directorates General (ie. Directorate General Fish Processing Product and Marketing, and Directorate General Aquaculture) under the MoMFA have a mandate to develop the mariculture industry sector in Indonesia. These two agencies have programs in place for mariculture development in many parts of Indonesia, including in SE Sulawesi.

With the implementation of Indonesian regulation No. 32/2004, which provides for local government at district level to have autonomy over management of their own economic affairs, the role of national government on the implementation of fisheries development programs at the provincial and district level is now limited. The primary authority is now at the provincial and district (Kabupaten/kota) level of local government, although the allocation of human resources for planning and implementation of fisheries programs at this level is quite limited.

Regulation No. 32/2004 on local government puts the the Provincial Marine and Fisheries Office (MFO) in the position as representative of the national government (Marine and Fisheries Affair Departement) at the local level, with the role of this office being focussed on coordination of various programs and projects between Jakarta and the local district government. The provincial MFO specifically has a limited authority to decide the continuity of fisheries activities in certain locations. This office proposes the amount of annual budget for marine and fisheries development at the local, district parliament (called DPRD Provincial), which also controls decision making on the allocation of annual budgets for relevant activities propose by district MFO. The source of money for local fisheries programs are from local government budgets called APBD. Both budgets (APBN and APBD) support expenditure for marine and fisheries development programs, fisheries infrastructure, production and processing activities, empowering local communities and many other programs related to fisheries. It should be noted that the fisheries programs in many places are based on direction from the national plan.

A summary of the institutional framework for marine and fisheries development programs in Indonesia is provided in Table 1, including the specific agencies, location, riole, level of authority and associated outputs.

Institutional Capacity at Local Government Level

As the lead agency at the local government level, the capacity of district MFOs to undertake the function of planning and implementation marine and fisheries development programs effectively and efficiently is limited due in part to the following issues:

- The MFO, as the lead agency in mariculture development at local government level, has merged with other government institutions which have a different focus.
- The capacity and capability of MFO officers to conduct marine and fisheries planning is constrained due limited skills-based training and experience relevant to marine and fisheries resources.
- The allocation of budget for fisheries development programs at the provincial level creates difficulties for implementation at the district level, particularly where programs are not targeted at stakeholder needs e.g. budgets targeting infrastructure when the priority sdhould be on technical assistance and supporting funds to offset operational costs.
- Regular technical and management assistance is limited for most mariculture programs implemented at the district level, and
- Most of the budget focus is on increasing the primary production of mariculture business and limited effort is put into encouraging value-adding to secondary products through quality control grading and processing of the products.

The mariculture industry in SE Sulawesi specifically needs many improvements to achieve and economically viable industrial scale. To facilitate development, priority consideration should be given to:

- Pilot support for MFOs at the three main mariculture production locations in SE Sulawesi (Kendari, Buton and Muna) as part of a provincial scale case study, with the emphasis being to encourage community-based economies and demand driven policies.
- Increasing the capacity provincial and district MFOs specifically relating to the management and technical support of mariculture businesses as well as for strategic planning of the sector.
- At the MoMFA level, there is a need to increase funding support for the development of mariculture and fishery sector as a whole.

Table 1. Summary of the Institutional Framework for Marine and Fisheries Development Programs in Indonesia

Agency	Location	Role	Authority	Output
National Parliament DPR	In National Capital	- Prepare and discuss the law, regulation, bill. - Discuss the allocation of sectoral budget at national level	- Approved the law, regulation, and bill. - Approved sectoral budget allocation at national level	- National Law, regulation and Bill. - Sectoral Budget Allocation at national level
Ministry of Marine and Fisheries (MoMFA)	In National Capital	- Prepare planning and implementation on Marine and Fisheries Program at the national level. - Propose and prepare the regulation on marine and fisheries level. - Propose the sectoral budget to National Parliament (DPR)	- Execute the national program based on budget allocation approved. - Execute the marine and fisheries regulation at national level - Distribute the fisheries national budget to Provincial Marine and Fisheries office to run the national program	- Sectoral fisheries regulation. - National marine and fisheries program. - National sectoral Budget for infrastructure. etc
Provincial Parliament (DPRD – Prov)	In Provincial Capital	- Prepare and discuss the law, regulation, bill at provincial level - Discuss the alocation of sectoral budget at provincial level	- Approved the law, regulation, and bill at provincial level. - Approved provincial budget allocation for development program	- Provincial Law, regulation and Bill to protect and maintain the development - Provincial Budget Allocation for Development program

Agency	Location	Role	Authority	Output
Provincial Marine and Fisheries Office (MFO)	In Provincial Capital	- Prepare planning and implementation on Marine and Fisheries Program at the provincial level. - Representative of Ministry of Marine and Fisheries at Provincial to conduct the program - Propose the sectoral budget to Provincial Parliament (DPRD- Prov)	- Execute the marine and fisheries national program at the provincial level. - Execute the marine and fisheries program based on budget allocated by Provincial Parliament	- National and Provincial marine and fisheries program.
District Parliament (DPRD Kabupaten/Kota)	In the Capital City of District	- Prepare and discuss the law, regulation, bill at district level - Discuss the alocation of sectoral budget at District level	- Approved the law, regulation, and bill at the district level. - Approved district budget allocation for development program	- regulation and Bill to protect and maintain the development program at the district level - District Budget Allocation for Development program
District Marine and Fisheries Office* (MOF)	In the Capital City of District	- Prepare planning and implementation on Marine and Fisheries Program at the district level. - Propose the sectoral budget to District Parliament (DPRD- Kabupaten / Kota)	- Execute the marine and fisheries program at the district level based on the budget allocated by District Parliament	- District marine and fisheries program.

* usually merged with other institution/office.

ANALYSIS OF MARICULTURE PRODUCER NETWORKS IN SOUTH-EAST SULAWESI, INDONESIA

Dinas Kelautan dan Perikanan

Provinsi Sulawesi Tenggara

(Provincial Agency of SE Sulawesi Marine Affairs and Fisheries)

in association with ACIAR Project SMAR /2007/225

"Mariculture Market Chain Development in SE Sulawesi"

and Project Partners:

University Haluoleo, Kendari SE Sulawesi

Network of Aquaculture Centres in Asia-Pacific

Fisheries Victoria, Department of Primary Industries, Victoria, Australia

June 2009

EXECUTIVE SUMMARY

Southeast Sulawesi is a province within Sulawesi Island, Indonesia. It has abundant natural resources of marine fisheries due to 77.55 % of its total administration area being bordered by the coastline. Fisheries and marine natural resources, including aquaculture, therefore play an important role in economic development in this province. It has been estimated that marine fisheries resources in this province exceed a potential yield of nearly 1.5 million metric tones per annum. Actual fisheries production for 2007 is estimated at >200,670 tonnes valued at >Rp. 3,310 billion (Annual Report of Fisheries, 2007). Most of the fishing activities are concentrated in the populated coastal area of the province. An estimated 60.9 % of fishing gears are still manually operated and traditional. However, over exploitation of wild stock and environmental degradation due to pollution are being experienced by traditional fisheries in some areas. This has been the major problem faced by local fisherman, in addition to lack of knowledge, high operational cost and low price of fish in local markets.

There are >120,000 fisheries households that base their livelihoods from fisheries in this province, particularly traditional sectors such as mariculture, which are reliant on manual, labour intensive practices. This situation provides for a major opportunity to develop mariculture into a more technologically and environmentally sound primary industry sector, particularly for seaweed and for complementary high value species such as groupers, abalones, sea cucumbers, pearl oysters and lobsters. Local government of SE-Sulawesi, Dinas Kelautan dan Perikanan (Marine and Fisheries Agency) is the lead regulatory agency in the Province, and provides some limited financial and technical support in the areas of marine farming, harvesting, processing and marketing to farmers in order to achieve not only optimum production but also sustainable practices.

A survey of mariculture operations in SE-Sulawesi has been conducted by the Dinas as part of the *Mariculture Market Chain Development* project funded by ACIAR/SMAR. The purpose of the survey is to gather data and precise information on the existing mariculture supply chain in the Province. More specifically, the survey aim was to undertake a feasibility analysis of establishing a producer network

and to determine what support is needed by farmers to further develop the mariculture sector using an agribusiness approach. The survey also identified future development opportunities for the mariculture sector, as well as technical improvement possibilities. The survey was conducted during the latter half of 2008 in Buton, Kendari and Muna, where most of mariculture activities occur presently. This report presents the findings of this survey, which are designed to feed into the findings and reporting of the overall ACIAR/SMAR project.

The survey was conducted based on structured questionnaires that had been customised for target culture species and associated production locations in SE Sulawesi. Primary data were obtained directly from interview with farmer groups, including group members and leaders, group trainers/liaison officers from Dinas Kelautan dan Perikanan, and local communities around the farms. Secondary data that support the primary data were obtained from Dinas Kelautan dan Perikanan, Dinas Statistik (Statistic Board) and Bappeda (Development Planning Agency) of the district where the surveys were conducted. For logistical reasons, farmer groups from each district were randomly sub-sampled on the basis that the data was representative of the district. Survey teams for data collection were organized by Dinas Kelautan dan Perikanan of SE-Sulawesi and asked to achieve the following goals:

- Existing and 'beginner' farmer group identification and associations
- Requirements for communication system development to improve market information, and
- Identification of specific information tools and inventories to facilitate access to marketing and technical information.

The findings of this survey emphasise that mariculture is developing in almost all of the coastline of SE-Sulawesi, but that medium to large farms are operated mainly in the areas of Buton and Muna islands and Kendari Bay. The potential area that can be developed for mariculture in the province is estimated at >230,000 ha. However, only an estimated (approx.) 52,000 ha has been exploited for mariculture activities to date. Species cultured are dominated by seaweed and higher value species such as groupers, pearl oysters and lobsters. Existing fisheries for high value products such as abalone and sea-cucumber have potential for further development utilising

mariculture production techniques. Seaweed is the most widely cultured species in the Province, as water quality parameters and ease of culture techniques facilitate uptake and successful culture outcomes. Mariculture in SE-Sulawesi does however posses some problems, including prohibitively high investment and operational costs, and limited technical knowledge and marketing access, which collectively are contributing to low production of mariculture farms.

To enhance existing supply chains by adopting a more agribusiness, market chain approach to industry development in SE-Sulawesi, there are several factors that need to be addressed, including:

- Identification and development of the key mariculture products
- Identification and development of a more effective and efficient market chain structure
- Investment in and development of key mariculture infrastructure
- Identification and development of key farmer groups, associations and networks.

Mariculture generates a reasonable income for farmer households and mariculture industry development is therefore expected to provide a flow of socio-economic benefits to the province as a whole. Income analysis shows that the dominant mariculture species (i.e. seaweeds, lobsters, sea cucumbers and groupers) will contribute a feasible income to the farmers of around Rp.15-24 million/month/fisheries household if larger farms are operated.

A recommended course of action to be taken from here, based on the findings of this survey, includes:

- Undertake a deeper socio-economic study of farmers and farmer groups in the villages and local communities, with emphasis on establishment of functional associations and networks; costings for a pilot case study are provided
- Follow up with further studies of the mariculture supply chain, products and markets including consultation with traders, with aim of establishing functional market chains

- Develop communication systems to enhance secondary market data collection via internet and institutional database access to support market chain functions and agribusiness capability of farmer groups and associations
- Identify opportunities to improve processing/value adding mariculture products to enhance economic viability of emerging market chains
- Identify opportunities for strategic investment in key mariculture production and post-harvest infrastructure to facilitate industry development
- Investigate options for bio-technology controls of pests and diseases, undertake technical training on husbandry and farm management and facilitate technical training and technology transfer to facilitate enhanced seed supply, husbandry and overall productivity:
- Undertake capacity building through enterprise training for farmers, groups and associations to enhance agribusiness capability at the production end of the chain

CONTENTS

I. INTRODUCTION

1.1 Background

Southeast Sulawesi is a province within Sulawesi Island with abundant natural resources of fisheries due to its geographical condition. It has 114,879 km^2 of marine territory area or 77.6 % of its total administration area of 153,019 km^2 with coastal line up to 1740 km. It consists of two large islands (Buton and Muna) and 534 small islands scattered around bays and straits. Therefore fisheries and marine natural resources, including aquaculture, play important roles in economic development in this province.

Currently, there are estimated 122,850 fisheries households that base their livelihoods from fisheries, particularly traditional and manual fisheries including traditional mariculture. This situation will bring broad opportunity to develop mariculture into more technologically and environmentally sound practices, particularly for high value species such as groupers, abalones, sea cucumbers and also staple commodities such as seaweeds.

Local government of SE-Sulawesi, Dinas Kelautan dan Perikanan (Marine and Fisheries Agency) in particular is responsible for developing and maintaining mariculture activities and their productions. This government board has issued some regulations, organized financial aids and provided expert advices in farming, harvesting, processing and marketing to the farmers in order to achieve not only optimum production but also sustainable practices. Financial aids of Dinas Kelautan dan Perikanan may come from National Government or overseas grant include The Mariculture Market Chain Development project under ACIAR/SMAR program. A summary description of the institutional framework within which the Dinas facilitates mariculture development in SE Sulawesi is provided by ICFSER (2008) in Attachment A.

1.2 Aim of this Study

The Mariculture Market Chain Development project under ACIAR/SMAR program will bring valuable input to mariculture development in SE Sulawesi. Through this project, surveys on mariculture operation in SE Sulawesi have been conducted to gather data and precise information on existing mariculture supply chains and to determine what support is needed by the farmers and fishers (producers). The purpose of the present study was to undertake a survey and analysis of existing mariculture producers in three selected study areas of SE Sulawesi, Kendari Bay and Buton and Muna Islands, to complement the concurrent survey and analysis of the existing mariculture supply chains in these areas. The specific objectives of this report are:

- To provide summary details of the existing mariculture producer networks in the three nominated study areas of Kendari, Buton and Muna, and
- To characterise existing producer networks, analyse available data and identify needs and future development opportunities for mariculture in SE Sulawesi.

The strategy to deliver on these objectives was to undertake field surveys in order to collect data to address four goals:

1. Farmer groups identification and their associations
2. Beginner farmer groups identification
3. Communication system development to improve market information
4. Information tools identification and inventarisation to ease the access of marketing and technical information such as mobile phones, radios, TVs, internet etc.

The study was undertaken by the Dinas Kelautan dan Perikanan under the surpervision of the Director, Mr. Hotman Hauturak.

2. METHODS

Primary data were obtained directly from interview with farmer groups (members/leaders), designated group trainer/liaison officers from Dinas Kelautan dan Perikanan, and communities around the farms. Questionnaires were completed by Dinas personnel in Indonesian (Bahasa) language, and the primary data was then collated, summarized and translated to English by the Fisheries Faculty, University Haluoleo.

Secondary data that support the primary data were obtained from Dinas Kelautan dan Perikanan, Dinas Statistik (Statistics Board) and Bappeda (Development Planning Agency) of the district where the surveys were conducted.

The survey was conducted based on a questionnaire that had been constructed with the emphasis on existing farmer 'groups', species cultured and their geographic locations. For the purposes of this survey, groups are defined as farmers co-located within a single village or neighborhood; typically consisting of approximately >2-10 households. A summary of the list of questions that were asked of the farmers and their groups is as follows:

1. Group name
2. Group leader
3. Location (district/village)
4. Commodities/species cultured
5. Group classification
6. Member (Number, male/female)
7. Group/member income
8. Group status
9. Production process
10. Group activities
11. Processing and marketing of cultured species
12. Financial aids/supports sources

13. Future development prediction
14. Support needed
15. Training attended and information access
16. Tools used to find information on marketing, processing techniques, financial management and culture technology

The designated study areas, Kendari Bay, Buton and Muna Islands, were specified by the overall ACIAR/SMAR project design. Farmer groups were randomly selected from existing 'registered groups' from within representative districts within each of these study areas. Registered groups are defined as groups recognized and registered with the Dinas for purposes of receiving financial and technical support from the Government, for collating production statistics and for general communications with the Dinas. The survey team from Dinas Kelautan dan Perikanan of SE Sulawesi, which undertook all field surveys, was as follows:

- Trikusna Team leader
- Abdul Kadir Team member
- Muh. Atid Team member
- Jusmiaty Team member

3. RESULTS AND DISCUSSION

Estimates of overall mariculture production, export and inter-island trade, participating households and associated information is provided for the key study areas in Tables A1-6.

The number of producer (farmer and fisher) groups and associated households (i.e. which draw primary income from mariculture or associated fishing activity) based on location and products or species in each of the key study areas during the 2008 survey is provided in Table A1. Most groups and households were surveyed in Buton (20/320), followed by Muna (18/149) and Kendari (9/149). Seaweed and grouper production is common in all areas, whereas pearl oyster production occurs only in Buton.

The number of producer groups and associated households based on primary source of enterprise financing and assistance in each of the key areas for the 2008 survey is provided in table A2. The majority of financing is sourced privately in Muna, although some non-private/government funding from the Dinas is also sourced by some groups. All finance is privately sourced in Buton and Kendari. Some financial assistance is also provided to farmers by the Dinas in Buton.

The estimated production, value and mean annual growth in the aquaculture sector for SE Sulawesi Province based on inter-island and export trade during the period 2003-07 is provided in Table A3. Whereas the volume of inter-island trade has increased positively on a mean, annual basis, with export volumes being more than triple domestic trade levels, mean annual value has decreased. The reason for the dramatic change in value between some years is unclear but may be due to shifts in scale of production and/or market demand for seaweed as a staple commodity for the region.

The estimated number of aquaculture households in SE Sulawesi Province based on culture type, for the period 2001-07, is provided in Table A4. These data show that the major aquaculture sector in the Province during this period is mariculture, with

not quite double the number of households involved compared with the next most important sector being brackishwater farming. The amount of change in participation rate has remained relatively stable during this period, although more recent data (not reported here) suggests a rapid increase in effort in the seaweed sector.

The estimated production levels for the different aquaculture sectors based on culture type during the period 2001-07 is proved in Table A5. These data reflect the relatively high participation rate in the mariculture sector, with production levels almost double outputs for brackishwater culture. Once again, the reasons for the dramatic change in production levels between some years is unclear but likely to be linked to changes in seaweed market demand and associated production levels in the region

The location, estimated area under cultivation and number of households involved in seaweed production in the province for the period 2003-08 is provided in Table A6. Two of the study areas for this survey, Buton and Muna, are clearly major seaweed production areas for the Province, with collectively over 30,000 households involved and >9000 ha under cultivation. The mean, annual increase in area and number of households for all areas combined is approximately 40%, but consistent with previous data, major changes is evident in area and participation between years and locations. It is likely that this is due to varying market demand, although ambient climatic and associated environmental conditions are also likely to be relevant.

Details of existing conditions and issues for mariculture farms in each district surveyed during this study are presented below.

3.1 Muna District

Muna District consists of northern Muna Island, western Buton Island, Tiworo Islands and 235 small islands around the main island of Muna.

The total area that has potential to be developed for mariculture farms is estimated to be 79,250 ha. There are an estimated total 150 mariculture farmer groups in Muna District, but only 50 farmer groups are registered with Dinas Kelautan dan Perikanan of Muna District. In this survey, of the 50 registered groups, 18 were randomly selected as a representative sample. Those 18 groups consist of 12 seaweed farmer groups, three grouper farmer groups, two lobster farmer groups and one sea cucumber farmer group.

3.2 Buton District

Buton district consists of southern Muna Island, southern Buton Island and some small islands surrounding the main island of Buton. This district is located at 05^0 $00^{"}$-6^0 $00^{"}$ and 123^0 08" – 123^0 $15^{"}$. There are an estimated total 165 mariculture farmer groups in Buton District, but only 60 farmer groups are registered with Dinas Kelautan dan Perikanan of Buton District. In this survey, of the 60 registered groups, 20 were randomly selected as a representative sample.

Mariculture is part of the culture and tradition of coastal communities of Buton, with livelihoods dependent on seaweed aquaculture in particular, long before more recent technical improvement of culture techniques became available. The seaweed culture tradition can be traced back to the late 1980's before the price of seaweed rocketed. Both production and number of farmers in seaweed culture rapidly increased with market prices in 2004. Now, almost all communities along the coastline of Buton culture seaweeds. Interestingly, most of the farmers are female; thought to be in part due to the inherent patient and nurturing nature of the female gender.

Seaweed species cultured in Buton is the red seaweed, *Kappaphycus alvarezii (Eucheuma cottonii)*. The major culture method is by using surface long-lines varying in length from 40 to 140 m; typically 40-70 m, but 30 % of the farmer groups use long-lines of 140 m. Seaweed seedlings, 50-100g in weight, are grown on the long-lines at 8–20 cm spacings. Grow-out period ranges from 35 to 65 days, but most farmer groups grow seaweed in 45 days as the best culture period.

Local government of Buton District has identified some potential area within its territory to develop mariculture farms. The development of mariculture is based partly on the need to provide sustainable alternative income sources and to protect valuable natural resources such as nearby coral reefs and seagrass beds. This concept has been formulated into government regulation to prevent environmental degradation of coastal resources. Also, local and traditional farmers are encouraged to build their farms and to join and/or establish farmer groups, rather than rely on foreign investors. The Dinas Kelautan dan Perikanan of Buton is responsible for the issue of farm permits, identification of farmer groups and determining that the farm activities will not pollute coastal waters and its resources.

Development of mariculture in Buton District will depend on availability of infrastructure to support farm activities, including access to farm/transportation, electricity, clean freshwater, telephones/access of information and communication, hatchery, handling and processing equipment and marketing access.

3.3 Kendari District

The city of Kendari is capital of SE-Sulawesi. It shares similar geographic condition with the former two district surveyed in this project. It has coastal line up to 295 km and 9 small islands surrounding the main land of Kendari. There are an estimated total 100 mariculture farmer groups in Kendari District, but only 50 farmer groups are registered with Dinas Kelautan dan Perikanan of Kendari District. In this survey, of the 50 registered groups, nine were randomly selected as a representative sample for the district.

Mariculture is an important sector with potential to improve community living standards in the Kendari Bay area. Also, development of mariculture is aimed to have multi-player, flow-on effect to other commercial sectors. Currently, farmers in Kendari culture primarily groupers, seaweeds and spiny lobsters, but there is also a substantial wild capture fishery for sea cucumber and abalone. A mixture of wild caught and hatchery produced seedstock (latter imported from Bali) is used for

grouper culture. Seaweed seedstock is self-propagated from cuttings and spiny lobster seedstock is provided from wild catch. An experimental-scale abalone hatchery is presently under development by the University of Haluoleo in Kendari Bay, providing potential for future development of cage abalone farming in the area. Cultured seaweed production has increased nearly 400% within the last three years (2006-08) due to high market demand increasing prices for this product.

Generally, some problems are identified as obstacles to the future development of mariculture in Kendari. These include unclear regulation on mariculture farm location, variable seed quality and availability of cultured species, water pollution, limited availability of capital, technological and infrastructure limitations and uninformed mariculture regulation.

4. FUTURE DEVELOPMENT

Due to its geographic location, SE Sulawesi has the advantage of having valuable natural fisheries resources, predicted to be in excess of 1,520 million tones sustainable annual yield. Actual fisheries production by the end of year 2007 was estimated at 200,672 tonnes, valued at (Ind.) Rp. 3,310 billion (Annual Report of Fisheries, 2007). Most fishing activities are concentrated in populated coastal areas. More than 60% of fishing gear is are still manually operated and traditional, however over exploitation of wild stock and environmental degradation due to pollution are being experienced by traditional fisheries in some areas. This has been the major problem faced by local fisherman. Also, lack of knowledge, high operational cost and low price of fish in local markets are being indentified as additional problems.

Based on existing conditions, mariculture is being encouraged by local government to enhance fisheries production and at the same time reduce environmental degradation, particularly in coral reef ecosystems, due to destructive fishing activities. Currently, mariculture is developing in almost all coastal areas of SE-Sulawesi, but medium to large farms are operated mainly in Buton, Muna and Kendari. Potential area that can be developed for mariculture is estimated to be in excess of 230,000 ha, of which an estimated 42,000-52,000 ha only has been exploited for mariculture activities already (see summary data below). Mariculture is dominated by seaweed, a staple commodity of the region, and more recently also higher value species such as groupers, pearl oysters and lobsters. Valuable capture fisheries for sea cucumber and abalone are also considered in the context of mariculture development in the present study, as both have potential to be cultured using both wild caught and hatchery-produced seed and viable, high value export markets exist.

Estimated potential and actual production for key fisheries sectors in SE Sulawesi in October, 2008 (Source: Dinas Perikanan Dan Kelautan, SE Sulawesi)

Sector	Potential production	Actual production
Marine capture fishery	1,520,340 tonnes	286,289 tonnes
Freshwater (lakes) capture fishery	98,000 tonnes	497 tonnes
Brackishwater aquaculture	44,699 ha	14,632 ha
Freshwater aquaculture	20,850 ha	1,275 ha
Mariculture	230,170 ha	42,572 ha

Seaweed is the most cultured product in SE Sulawesi as water quality parameters and ease of culture techniques facilitate culture success of this product. Problems confronting mariculture development in SE Sulawesi include the high initial investment cost and limited availability of capital, high operational costs, limited technical knowledge and market access.

4.1 Development of Mariculture Sector, Products and Market Chain

There are a number of key factors to consider for future development of the mariculture industry sector in SE Sulawesi. A focus on market chain development is expected to provide a large contribution to reducing unemployment (i.e. mariculture is 'pro-job' creation), reduce the number of poor people (i.e. 'pro-poor' alleviation) and increase economic growth (i.e. 'pro-growth' development) in the region. The development of mariculture can be used as an alternative livelihood for traditional fisherman, and thereby has the potential to reduce environmental pressures due to

destructive and unfriendly fishing practices on natural marine resources in sensitive coastal areas.

Species cultured in mariculture are generally high value species that can be exported to international markets. However, existing supply chains are relatively long with many intermediaries causing problems and reducing economic returns for traditional and local farmers and fishers (Fig. 1). Products are typically sold at relatively low price to the local or village-based 'collector' (also referred to as 'trader') close to where the farms exist and/or fish are landed. This situation could be improved through developing a more functional 'market chain', including forming local industries for processing and value-adding to cultured products before being exported to international markets. A proposed functional market chain model for industrial scale production of seaweed in SE Sulawesi is clearly described in Fig.2. This model features a more direct linkage between local producers and processors; the latter of which are intended to add value to the raw product through enhanced drying and possible extraction of valuable thickeners for food processing. Farmers presently sell semi-dried raw product only to collectors/traders, with all further processing/value adding occurring in Makassar and Surabaya and in other export market destinations. The proposed market chain model aims to more equitably share the value of the raw product with local producers and also aims to capture more of the value for enhancing local employment and economic growth. The existing network of traders is still required to facilitate inter-island and export trade.

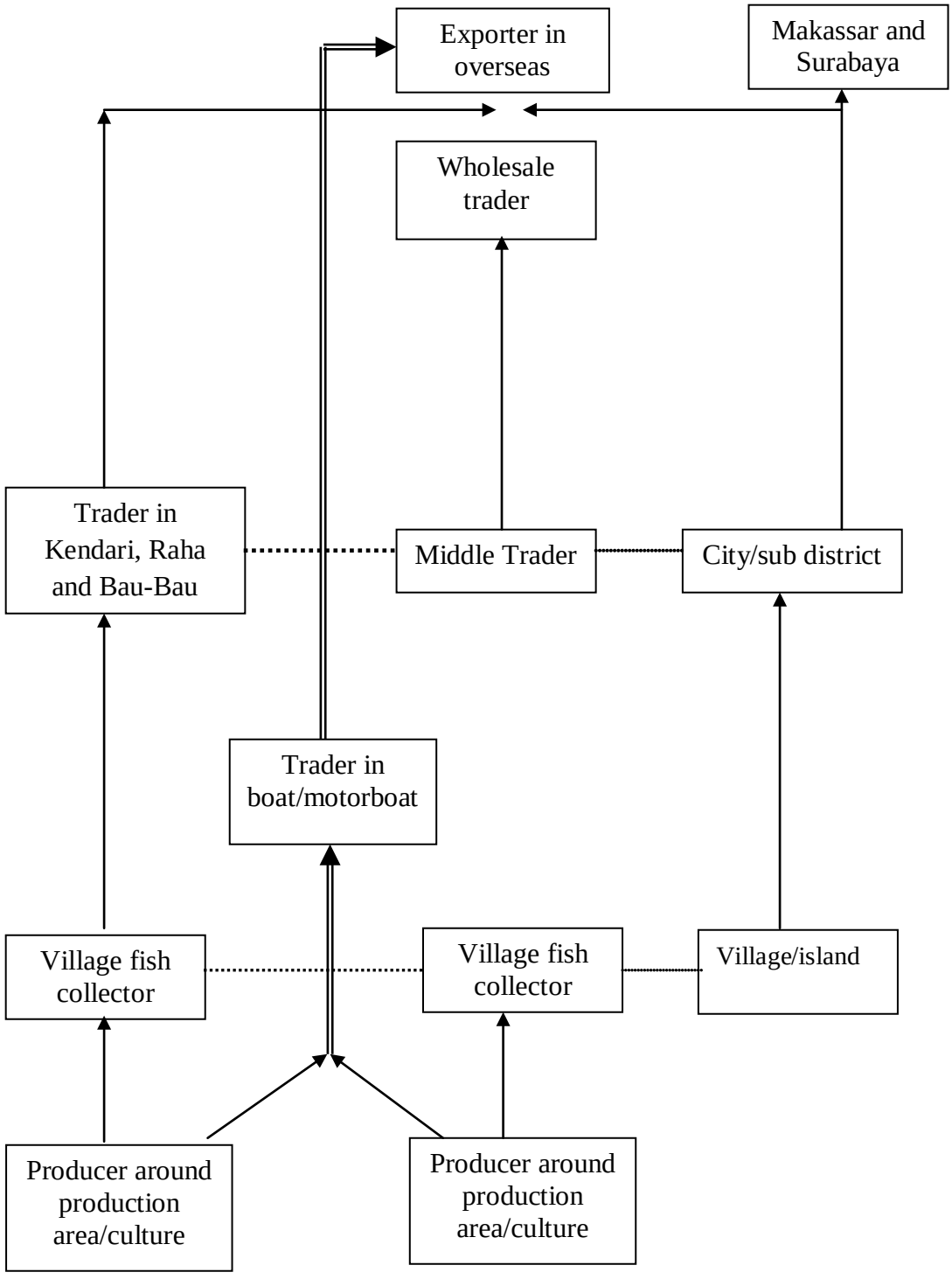

Figure 1. Existing supply chain of mariculture products in SE Sulawesi

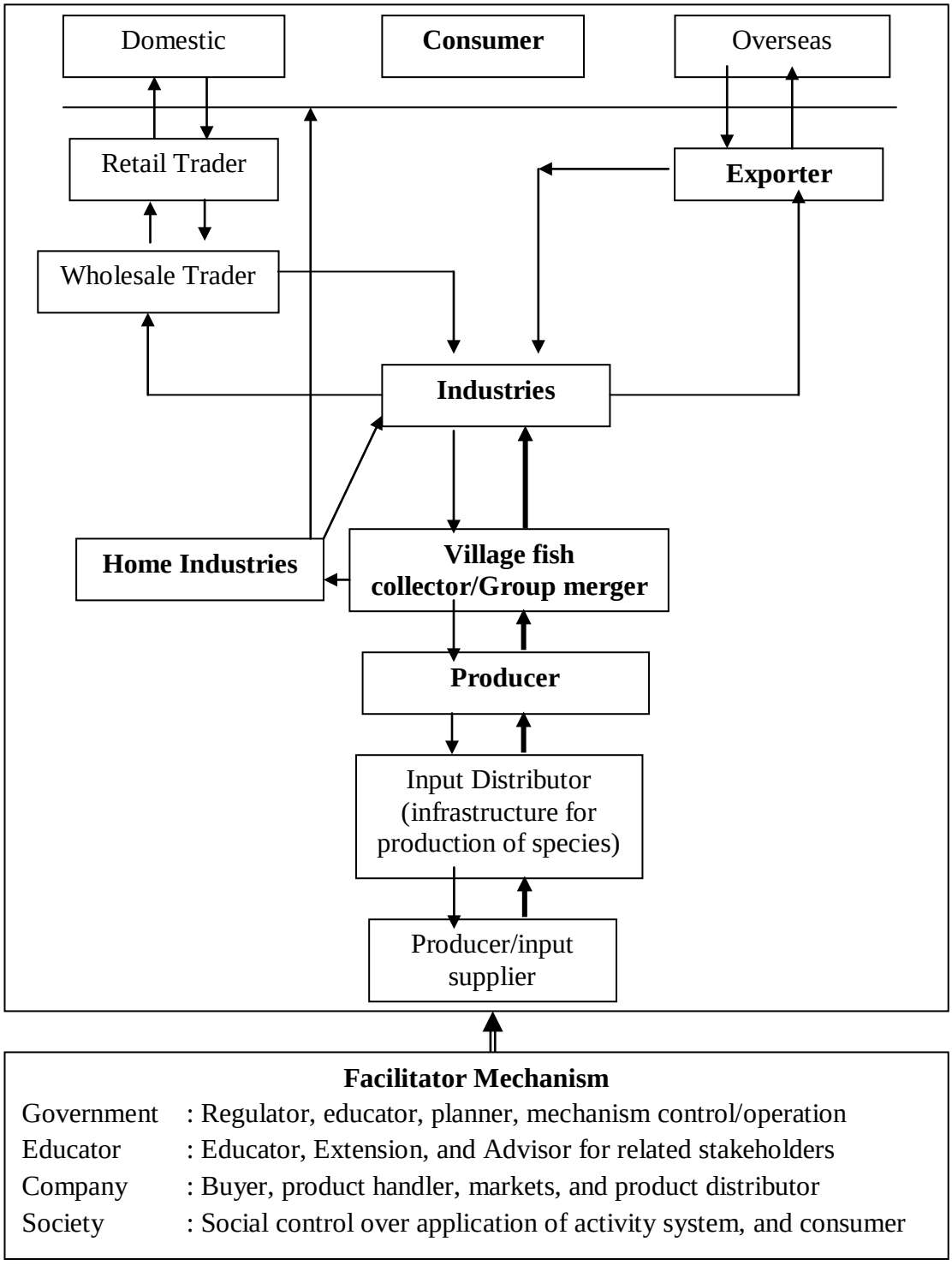

Figure 2. Proposed functional market chain system for industrial-scale seaweed production in SE Sulawesi

4.2 Mariculture Infrastructure, Investment and Income Level

Development of infrastructure is important to support mariculture activities in SE Sulawesi, including communication and information systems, transportation, electricity, warehousing, clean freshwater facilities and production facilities.

Financial support for mariculture is expected from government and investment bodies such as banks, rather than the farmers themselves. Foreign investors from other provinces and other countries are also expected to come to SE Sulawesi to accelerate development, although such investment will need to be appropriately regulated and balanced to ensure equitable outcomes for local stakeholders.

Mariculture development in SE Sulawesi is expected to generate a reasonable income for small-holder farmer households. Income analysis shows that seaweeds, lobsters, sea cucumbers and groupers are likely to be the dominant culture products with feasible potential to provide income to the farmers of around Rp. 15-24 million/month/household if larger farms are operated. Projected income level for each commodity is estimated as follows:

- Seaweed: B/C ratio for seaweed culture from 2 Ha area of 11.64, with income level of Rp.15,156,250/month.
- Spiny lobster: B/C ratio for lobster culture from 2 units of fixed net cage of 2.13, with income level of Rp.17,147,917/month.
- Sea cucumber: B/C ratio for sea cucumber culture from 1 Ha of 4.25, with income level of Rp.22,770,833/month.
- Grouper: B/C ratio for grouper culture from 2 units of floating net cage of 2.87, with income level of Rp.24,343,750/month.

Presently, most farmer groups manage only relatively small farms due to previously mentioned problems, and actual incomes are therefore less than projected. To achieve increased income and prosperity for coastal communities from mariculture development, improvement and development of infrastructure through capital investment and good farm management are required.

4.3 Mariculture producer groups, associations and networks

The survey findings highlight the need for and high level of support from farmers for the formation of a network of farmer groups and association. To a large extent, farmers are already organized into logical, geographically-based groupings with specific product and species focus, depending on where they are. Where groups do not already exist could readily form into groups simply on the basis of existing village and district arrangements. This also applies to fishers targeting species with potential for development as mariculture species such as abalone and sea-cucumber, as well as fishers providing trash fish for mariculture feeds and wild-caught juveniles as mariculture seedstock. All such farmers and fishers are either one and the same, where households have already diversified, or are co-located in villages so that horizontal business integration can be easily realized.

All surveyed groups have been recorded with key contacts and direct (100% preferred) contact details. All (100%) of surveyed farmer groups have indentified a requirement for skills-based training in production, marketing and other associated agribusiness disciplines. They have also completely agreed with the need for improved and expanded production and post-harvest infrastructure and the willingness to support and participate in a more functional mariculture market chain with an emphasis on both domestic and export trade. The key groups identified for the purposes of undertaking a pilot mariculture farmer association network in SE Sulawesi are provided in Table A7. The estimated costs for initiating such a pilot are provided in Table A8.

5. CONCLUSIONS AND RECOMMENDATIONS

Development of the mariculture industry has the potential to increase prosperity and overall provide a brighter future for coastal communities in SE-Sulawesi, but many issues need to be addressed and improvements made in order to achieve this goal. In this context, several important factors and/or requirements are listed below for consideration:

- Consistency of government regulations from national to local government in mariculture development
- Rational and stable market chain for mariculture species and products
- Adequate financial support for farmers from financing boards/bodies
- Adequate production and post-harvest infrastructure to enhance access to the mariculture farming sector
- Technological and expert support from scientists and Research and Development agencies to facilitate enhanced and productivity
- Continuity and stability of high quality, cost-effective seedstock supply
- Sufficient training for farmers to improve mariculture techniques and practices, business enterprise and marketing.

Based on these considerations, specific actions which may be taken to facilitate mariculture industry development in SE Sulawesi Province may include:

- Undertake a deeper socio-economic study of farmers and farmer groups in the villages and local communities, with emphasis on establishment of functional associations and networks

  During the first short site visit for the present study, interviews were completed to undertake an initial situation and needs analysis, but a more detailed analysis of farming activities at the sites was not possible in the time available. There is a need to have more precise estimates of the actual number of farmers and their

socio-economic profile for purpose of undertaking collective actions to benefit groups in specified areas. The emphasis in the first instance needs to be on establishment of pilot farmer associations and networks in the key regions and for key species. Costings for establishment of such a pilot case study have been provided.

- Follow up with further studies of the mariculture supply chain, products and markets including consultation with traders, with aim of establishing functional market chains

Existing supply chains are excessively complex, product is undervalued and the share of the product value is unevenly distributed throughout the chain, with producers being most disadvantaged. There is inconsistent sharing of information between the chain participants and partnerships are not a major feature. Overall the supply chain is not optimized to the advantage of producers and therefore only semi-functional. A 'through chain' or market chain approach is recommended where market information and product value is more appropriately shared.

- Develop communication systems to enhance secondary market data collection via internet and institutional database access to support market chain functions and agribusiness capability of farmer groups and associations

More comprehensive, reliable and timely market information is required on about market trends of key mariculture products and main competitors at national and international levels. Problems of quality and market preferences for specific varieties must be better understood by farmers and fishers. Presently, producers are putting products into the market place in the absence of real-time data on demand, price and quality. This limits the ability of producers to adopt agribusiness approach to enterprise. More cost-effective and efficient information systems are required via internet and institutional database access, for better comparative understanding of issues and application of learnings from other experiences relating to consumer trends, quality certification, risks from

competition etc. Communication with and between existing farmer groups is presently limited and inefficient and not conducive to facilitating improvement, development and expansion.

- Identify opportunities for strategic investment in key mariculture production and post-harvest infrastructure and to improve processing/value adding mariculture products to enhance economic viability of emerging market chains and to facilitate industry development

An immediate and highly relevant example is for looking at cost-effective ways of improving seaweed drying methods to increase unit prices to farmers. Value adding to seaweed by introducing processed seaweed methods to extract high-value, food-grade thickeners is also an important opportunity, rather than continuing to export raw (semi-dried) product only. Farmer access to capital is limited and therefore production infrastructure is limited in scale and sophistication due to limited investment.

- Investigate options for bio-technology controls of pests and diseases, undertake technical training on husbandry and farm management and facilitate technical training and technology transfer to facilitate enhanced seed supply, husbandry and overall productivity:

In SE Sulawesi, farmers say that pest control is one of their major problems. Options for developing and/or introducing sustainable and cost-effective biotech-based, biological controls as part of an integrated pest management system for mariculture, need to be investigated. Ice-ice (white tip) disease in seaweed is presently a major concern for producers. Seedstock and feed supply and is limited and presently dependent on wild catch in most cases. Hatchery seed and semi-processed feeds are likely to enhance productivity and environmental sustainability. Production systems and husbandry and health management methods need improvement to be more cost-effective and sustainable. Technical training on mariculture husbandry and farm management is required to improve overall productivity and progress towards Better Management Practice.

Collaboration of farmers with the Regional Fishery Training Center of the Provincial Agriculture Office to assist the communities in the site selection, training on planting (seaweed), seeding, care, management and monitoring of mariculture products project is required.

- Undertake capacity building through enterprise training for farmers, groups and associations to enhance agribusiness capability at the production end of the chain

Farmers need assistance to organize themselves into formal groups and associations to facilitate enhanced training and market information, in turn to increase effective marketing and profitability. Immediate priority is to support existing supply chains, with a focus on value-adding and diversification to higher values products at a later date. Capacity building and enterprise training for farmers should be organised in two phases. Firstly, by establishing linkages with existing organizations and institutions, e.g. ACIAR, NACA, DPI, local and national NGOs etc. Secondly, by arranging for village-based mariculture producers who are interested or involved with business or marketing products of the community. The training should give general information on basic enterprise building and management and will facilitate actual application to existing businesses/enterprise. A pilot project designed to develop and implement farmer associations and networking is required.

ACKNOWLEDGEMENTS

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APPENDICES

Table A1. Number of producer (farmer/fisher) groups and associated household members based on location and commodities produced in each of the key study areas during 2008 survey.

District/City	Number of Groups	Number of Household Members	Location		Commodity types	
			Sub district	Village	Main	Other
Muna	2	20	Duruka	Lagasa	Grouper	Seaweed
	5	52	Duruka	Ghone Balano	Seaweed	Fishing
	4	35	Lasalepa	La Bone	Seaweed	Fishing/Farmer
	3	16	Napabalamo	Renda	Sea Cucumber	Fishing
	1	3	Napabalamo	Bahari	Spiny Lobster	Sea Cucumber
	2	17	Duruka	Lasunapa	Seaweed	Fishing
	1	6	Napabalamo	Tampo	Seaweed	Fishing
Total	**18**	**149**	**3**	**7**	**4**	**4**
Buton	2	20	Lakudo	Nepa Mekar	Seaweed	-
	2	150	Lakudo	One Waraa	Seaweed	Pearl Oyster
	3	28	Lakudo	Boneoge	Pearl Oyster	-
	4	35	Kopontori	Natumotobe	Sea Cucumber	-
	6	70	Kopontori	Lambusango	Grouper	-
	3	17	Kopontori	Lolibu	Seaweed	Grouper
Total	**20**	**320**	**2**	**6**	**4**	**2**
Kendari	2	37	Soropia	Bajo Indah	Seaweed	Fishing
	3	54	Soropia	Mekar	Seaweed	
	3	37	Soropia	Bokori	Spiny Lobster	
	1	21	Soropia	Tapulaga	Grouper	
Total	**9**	**149**	**1**	**4**	**3**	**1**
Overall Total	**47**	**618**	**6**	**17**	**5**	**6**

Table A2. Number of producer (farmer/fisher) groups and associated household members based on primary source of financing and assistance provided in each of key study areas during 2008 survey

District/City	Number of Groups	Number of Household Members	Source of Financing		Source of Assistance	
			Private (%)	Non Private (%)	District Agency of Marine Affairs and Fisheries (% &/or Rp)	Others (%)
Muna						
	2	20	70	30	50	50
	5	52	50	50	100	-
	4	35	100	-	100	-
	3	16	100	-	80	20
	1	3	80	20	-	100
	2	17	-	100	-	100
	1	6	100	-	-	100
Buton						
	2	20	100	-	20,000,000	100
	2	150	100	-	20,000,000	100
	3	28	100	-	15,000,000	100
	4	35	100	-	1,500,000	100
	6	70	100	-	75,000,000	100
	3	17	100	-	75,000,000	100
Kendari						
	2	37	100			100
	3	54	100	-		100
	3	37	100	-		100
	1	21	100	-		100

Table A3. Estimated production, value and mean annual growth in the aquaculture sector of SE Sulawesi Province based on export and inter-island trade during the period 2003-07.

Trade	Year					Mean, Annual Growth (%)
	2003	2004	2005	2006	2007	
Export						
Volume (Tonnes)	2,283	3,210	3,243	5,644	4,146	22.3
Value (million Rp)	108,893	127,304	127,616	35,356	44,217	-7.5
Inter- island						
Volume (Tonnes)	10,077	3,939	3,955	6,685	8,210	7.8
Value (million Rp)	109,060	22,918	23,028	36,208	42,693	-0.8

Tabel A4. Estimated number of aquaculture households* in SE Sulawesi Province based on culture type, for the period 2001-07

Culture Type	Year							Increase (%)		
								2006- 2007	2001- 2007	
	2001	2002	2003	2004	2005	2006	2007	Total	Total	Mean, annual
Brackishwater	4,916	5,403	5,485	6,003	5,044	5,240	6,444	23.0	31.0	5.3
Freshwater	2,011	2,284	2,312	1,768	1,506	1,798	1,741	-3.2	13.4	-1.2
Marine	9,929	10,065	10,157	10,217	10,469	10,756	10,825	0.6	9.0	1.4
Total	16,856	17,752	17,954	17,988	17,019	17,794	19,010	6.8	12.8	2.1

* households in which aquaculture provides the primary source of income

Tabel A5. Estimated aquaculture production (tonnage) in SE Sulawesi Province based on culture type, for the period 2001-07.

Culture Type	Production (tonnage)							Increase (%)		
								2006- 2007	2001- 2007	
	2001	2002	2003	2004	2005	2006	2007	Total	Total	Mean
Brackishwater	19,664	19,716	20,019	10,943	5,836	4,065	6,955	71.1	-64.4	-8.5
Freshwater	6,033	6,035	6,081	1,172	1,726	1,740	1,967	13.0	-67.4	-3.1
Mariculture	24,871	24,950	25,355	1,351	11,176	11,316	11,829	4.5	-52.4	106.7
Total	50,568	50,701	51,455	13,466	18,738	17,121	20,751	21.2	-59.0	-3.4

Table A6. Location, estimated area under cultivation (ha) and number (N) of households involved in seaweed production in SE Sulawesi Province for the period 2003-08.

District/City	2003		2004		2005		2006		2007		2008		Mean annual increase 2003-08 (%)	
	Area (ha)	H'holds (N)	Area (ha)	H'holds (N)	Area (ha)	H'holds (N)	Area (ha)	H'holds (N)	Area (ha)	H'holds (N)	Area (ha)	H'holds (N)	Area	H'holds
Kolaka Utara	9.5	33.0	15.4	54.0	23.4	80.0	29.2	102	39.2	137	304	1,064	169.7	170.0
Kolaka	211	887	298	1,250	388	1,630	522	2,191	695	2,921	3,150	12,600	98.4	94.1
Konawe	69.7	230	113	373	144	474	180	593	240	790	1,002	4,008	93.1	111.0
Konawe Utara	137	410	191	572	250	750	323	969	431	1,722	656	2,624	37.0	46.0
Konsel	75.4	241	88.0	282	135	432	225	898	299	1,314	558	2,232	51.3	58.8
Bombana	143	572	191	765	249	994	311	1,242	426	1,702	810	3,240	43.2	43.2
Kota Kendari	60.6	218	63.2	228	79.8	287	100	359	176	634	273	1,091	37.4	40.8
Muna	339	1,017	424	1,271	670	2,680	842	3,368	1,122	4,490	3,104	12,416	63.7	74.3
Buton Utara	353	1,059	456	1,368	621	1,863	764	2,292	1,002	3,006	1,330	3,991	30.5	30.5
Buton	1,765	6,001	2,251	7,653	2,923	9,939	3,654	12,424	4,872	19,489	5,954	17,862	27.6	26.2
Kota Bau-bau	76.0	266	118	411	153	610	191	763	254	890	407	1,424	40.6	40.9
Wakatobi	720	3,024	735	3,087	937	3,934	1,171	4,683	1,960	7,841	2,911	9,315	33.7	26.9
Total	**3,959**	**13,958**	**4,944**	**17,314**	**6,573**	**23,673**	**8,312**	**29,884**	**11,516**	**44,936**	**20,459**	**71,867**	**40.1**	**39.4**

Table A7. Summary of group location/names, key products of interest, contact persons and indicative funding requirement for pilot case study on establishment and implementation of mariculture producer network in SE Sulawesi Province.

Study area	Name of group	Product*	Contact person	Location and District		Funding Requirement (Rp)
Kendari Bay						
1	Kerapu Jaya	Kerapu	Arifin	Bokori	Soropia	90,000,000
2	Samudera	Rumput Laut	Ahyar	Bokori	Soropia	55,000,000
3	Usaba bersama	Lobster	Yuyun	Melar	Soropia	70,000,000
4	Lesari	Mutiara	Tawing	Tapolaga	Soropia	45,000,000
5	Furirano	Abalone		Maa	Kendari	90,000,000
Muna Island						
1	Bunga Tanjung	Rumput Laut (seaweed)	Laode Musa	Ghonebalano	Duruka	90,000,000
2	Rerda Bakti	Kerapu (grouper)	Baking	Rerda	Napabalano	55,000,000
3	Lestari	Lobster	Sahrun	Balari timur	Napabalano	70,000,000
4	Sejahtera	Teripang	H Apang	Ling IV	Napabalano	45,000,000
5	Mujur Jaya	Rumput laut	Nur Aisyah	Lasunapa	Duruka	90,000,000
		Abalone		P.	Tiworo	50,000,000
Buton Island						
1	Sederhana	Rumput Laut	La uda	Boneoge	Lakudo	90,000,000
2	Posisir Ogena	Teripang	Laode Ziyni	Boneoge	Lakudo	55,000,000
3	Mujur	Kerapu	Jafar	Loibu	Kapontori	70,000,000
4	Mabe Jaya	Mutiara	Zahunu	Matumotobe	Kapontori	45,000,000
5	Bone Montete	Rumput laut	Ismail	Ore Waara	Lakudo	90,000,000
		Lobster		Loibu	Kapontori	70,000,000
					Total	**1,170,000,000**

* Kerapu – grouper; Rumput Laut – seaweed; Teripang – sea cucumber; Mutiara – pearl oyster

Table A8. Cost estimate for proposed case study of development and pilot implementation of mariculture group/association network in three regions of SE Sulawesi Province

Activity/cost item	Volume	Unit price (Rp)	Total cost (Rp)
Levying of computer laptop + Infocus software	1 Unit	35,000,000	35,000,000
Levying of digital camera	1 Unit	3,500,000	3.500.000
Stocktaking/identify network and marketing effort for six groups: (5 products in 3 regions)	5 x products in 3 x regions	15,000,000	225,000,000
Consultative meetings with mariculture groups & investors in3 regions	3 regions	95,000,000	285,000,000
Develop capacity and address skill-based training needs	5 x products in 3 x regions	65,000,000	975,000,000
Repair and reinforcement of mariculture production & post-harvest facilities & infrastructure	1 unit Across network	1,200,000,000	1,200,000,000
Compilation of case study reports	10 units	500,000	5,000,000
Levying of ATK (flash Disc, paper, inking, map, exelen, etc)	1 Unit	2,500,000	2,500,000
Project documentation etc.	1 unit	5,000,000	5,000,000
Automobile	1 unit	197,500,000	197,500,000
Motorcycle	4 units	20,000,000	80,000,000
Total			**3,013,500,000**

Mariculture Development Opportunities in SE Sulawesi, Indonesia

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The island of Sulawesi (38,139 km^2) with a coastal area of 114,879 km^2 and a coast line of 1,740 km is recognized by the government of Indonesia as a major area for development of mariculture. Within Sulawesi , one of the least developed areas is SE Sulawesi Province, which consists of 12 Districts, comprising ten regencies and two towns, including Kendari which is the major population and commercial centre.

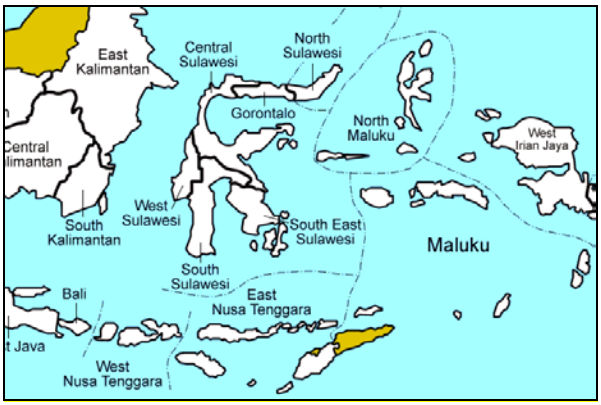
SE Sulawesi is a relatively impoverished region of Indonesia. The fishery related activities are of importance to this region and currently estimated to account for about 12 percent of the annual GDP, to which mariculture contributes approximately 3-4 percent. In 2007 aquaculture production in the Province reached 153,160 t, valued at approximately 1000 billion IndRp, with seaweed production showing the highest growth. A total of 115,483 households and 160,140 persons were involved in aquaculture in the Province.

SE Sulawesi and the associated islands have many accessible and well sheltered bays and inlets with abundant natural resources, including good water quality, for mariculture. Resident coastal communities are eager to increase their quality of life through adoption and development of commercial production systems for various local products including grouper, seaweed, lobster, abalone, pearl oyster and sea cucumber.

Mariculture and fisheries development is often seen as an important strategy to contribute to poverty alleviation of rural coastal communities. The Government of Indonesia, having recognized this fact, is in the process of initiating development activities in partnership with the Australian Government through the 'Smallholder Agribusiness Development Initiative' (SADI). The purpose of this initiative is to reduce poverty and improve livelihoods for smallholders in eastern Indonesia.

The Australian Centre for International Agricultural Research (ACIAR).coordinates the 'Support for Market Driven Adaptive Research' (SMAR[*]) sub-program of SADI.

[*] The purpose of SMAR is to develop strengthened, province-based agricultural R&D capacity that is market and client-driven and effectively transferring knowledge between stakeholders.



Location of SE Sulawesi within the Indonesian archipelago

This paper provides a brief introduction to mariculture activities for selected species in Kendari Bay, one of the main production regions in SE Sulawesi. It also outlines a new ACIAR-SADI funded project entitled 'Mariculture Market Chain Development in SE Sulwesi' being undertaken on a collaborative basis by Haluoleo University and the Dinas Perikanan (provincial fisheries service) in SE Sulawesi, the Indonesian Centre for Marine and Fisheries Socio-Economic Research, the Network of Aquaculture Centres in Asia-Pacific and the Department of Primary Industries (Victoria, Australia).

Grouper farming:

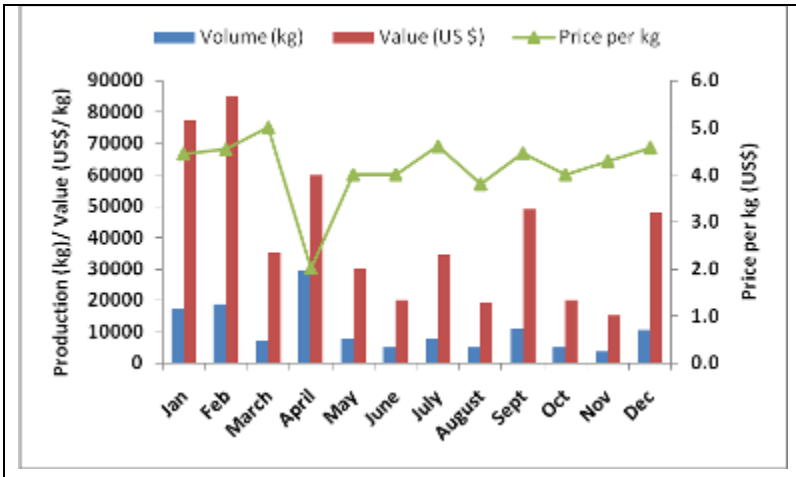
Grouper farming is one of the most popular mariculture activities in the Kendari region. The main species farmed are the mouse grouper, *Cromileptes altivelis,* tiger grouper (*Epinephelus fusgoguttatus*) and possibly greasy grouper (*E. tauvina*). The farming activity essentially consists of the fattening of 5-7cm fingerlings, most of which are procured from hatcheries in Situbondo, Java and from Bali Island. The price of fingerlings is based on the length; a 1 cm fish costing around 3000 Rp on delivery at the site.

The grouper are fattened in net cages (5 x 5 x 3m), of wooden or bamboo frames; each farmer owning and managing up to four-six cages. They are fed small, low-valued fish species, more often than not caught by the farmers themselves by gill netting, or from fixed weirs erected by the farmers (locally known as sero). The latter is a traditional mode of fishing, with the weir ownership passing hands from generation to generation. During the peak season, 50- 80kg of fish are caught each day. Some of the larger operators obtain the low-valued fish through contracted artisanal fishers, purchased at around 12-20,000 Rp/kg, depending on the season.

Typical cage farms in Kendari Bay, SE Sulawesi

A typical weir (sero) used for catching low valued fish

Almost all farmed grouper are exported live to Hong Kong. Fish are harvested at a size ranging from 0.5 to 0.75 kg. Live haul boats arrive in the region on a regular basis and all transactions are cash-based.



Monthly changes in live grouper production in SE Sulawesi, the total revenue and price per kg in 2007. Based on data from Dinas Kelautan Dan Perikanan (Provincial Fishery Service)

Farming of grouper occurs through the year, with a peak period from December to March. In general, the farm-gate price of live grouper is relatively static through the year, with a marginal increase during February- March, the time of the Chinese New Year, and a rapid drop in the following month e.g. the price in the live fish restaurant trade in Hong Kong and Singapore ranges from about US $ 14 to 20, depending on the season and the species, as compared to the average farm-gate price of US$ 5 / kg. Mouse grouper often commands a 20-30% higher price than the tiger grouper. Interestingly, the almost complete dependence of SE Sulawesi grouper farming on hatchery-reared seed stock is heartening, especially from sustainability and biodiversity view points, and should be encouraged.

Spiny lobster farming

The most commonly farmed spiny lobster species is *Panilurus versicolor*. The type of cage used (5 x 5x 3 m), and the farming activity, including the procurement of low-valued fish for feed is very similar to that for grouper farming. However, in this instance the seed stocked, as in other parts of SE Asia, is wild caught. The wild seed stock supply is based on a tribe-based artisanal fishery in the

waters surrounding the Tiworo Islands. The available seed stock are typically young lobster of about 100 g in weight (9-12 individuals/kg), costing 300,000Rp/kg (approximately US$10-12). They are fattened for 12-14 months and sold live to local wholesalers for export.

A lobster farmer with a young animal

Lobsters are stocked at a density of 50 pcs/cage and harvested at a size of about 750-1000 g. The feeding of lobsters is well controlled, with each lobster typically being fed 1-2 (small, low-valued) fish per day. Most lobster farmers have their own sero (weir) for harvesting fish to feed lobsters. Lobster farmers also believe that putting papaya (*Carica papaya*) leaves and stems into the cages increases the moulting frequency and hence growth. Although indigenous knowledge may not necessarily be backed up by science, there may be a need to more closely investigate such an issue as a means of determining whether further improvements could be brought about in the spiny lobster production system.

The provincial fishery service (Dinas Perikanan), through an Indonesian Government sponsored a program to encourage lobster farming, provided free seed stock to farmers in 2007 and 2008. The mortality rates in lobster farming are very low, and thus far disease problems have not surfaced. These factors have contributed to a significant shift to lobster farming from grouper. This shift has been further encouraged by the increasing cost of hatchery-based grouper seed, primarily brought about from increases in cost of transportation of seed over long distances.

Seaweed farming

Seaweed farming is a predominant activity in SE Sulawesi, largely because of the accessibility of protected inshore waters and the ideal ambient environmental conditions, the very low investment costs involved and strong market demand for the product. Although typically a lower valued product compared to other mariculture species, the farm-gate price of dried seaweed has more than doubled over the last several months, and currently ranges from 16,500 to 17,000 Rp/ kg. The commonly cultured seaweed is *Kappaphycus cottoni* (formerly *Eucheuma).* Unlike grouper and lobster farming, seaweed farming is typically a family activity, with all adults of the household being involved in one way or the other.

In the province, seaweed farming is conducted in community-based clusters, with each consisting of 10-15 (and up to 60) families managing/owning an area of about 1-2 ha/family. The harvesting season is June-December, with about four-five harvests/year, averaging 1-1.5 t (dry weight)/harvest. Although seaweed farming is currently profitable, it is also a farming system that is very environmentally friendly as it is carbon sequestering. In the recent past it has encountered some disease problems, in particular “ice-ice”, caused by reduced salinity from increased freshwater run-off into Kendari Bay.

Cultured *Kappaphycus cottoni* ready for harvest in Kendari Bay

A seaweed farming cluster, Kendari bay

According to the farmers, two strains are farmed in the area, with one being faster growing and more resistant to disease. Farmers also believe that the quality of the available seed stock has deteriorated over the years.

Market chain and industry development

The new ACIAR project in SE Sulawesi is a scoping study with the objectives to:

- Facilitate local leadership and support for mariculture industry development
- Identify opportunities for adopting market driven, agibusiness approach to development for smallholders, and
- Prepare an industry development strategy with local stakeholder network.

Key initial activities for the project are to undertake a baseline survey to characterise and map existing mariculture supply chain dynamics in the province, with the emphasis being on a combination of high (abalone, grouper, spiny lobster, sea cucumber) and low-valued (seaweed) species and products in Kendari Bay (see opposite) and Buton and Muna Islands.

The existing supply chain is heavily dependent on environmental inputs of water, nutrients, seed and feed, etc, and is traditionally structured in terms of the key 'production, distribution and consumer' sectors. It has limited information flow between the sectors, disproportionate sharing of the value of the products between supply chains participants and is constrained by limited inputs (e.g. seedstock), capital, infrastructure, skills and lack of a coordinated marketing strategy. On the positive side, natural resources are still plentiful/underexploited, diverse and relatively unmodified.

Local stakeholders are enthusiastic about the opportunities and have a desire to improve their livelihoods through consideration of strategic intervention and practice change. The scoping study is due for completion in mid 2009, at which time the feasibility will be determined of progressing to a 'stage 2 – market chain/industry development phase'.

A look into the future

The mariculture practices in the SE Sulawesi region are mostly simple, environmentally friendly, and can be considered as an ecosystem-based approach to mariculture, provided that the there is no over expansion and intensification in the foreseeable future. Perhaps one of the main drivers in this regard is that the practices tend to remain as a community-based activity, coordinated through village committees in such a manner that they are within the financial capabilities of the mostly

smallholder farmers. A further strengthening of the village committees through enhanced networking, as well as forming clusters amongst villages, could lead not only to improvements in the practices per se but also enable market opportunities and improved trade of the farmed commodities.

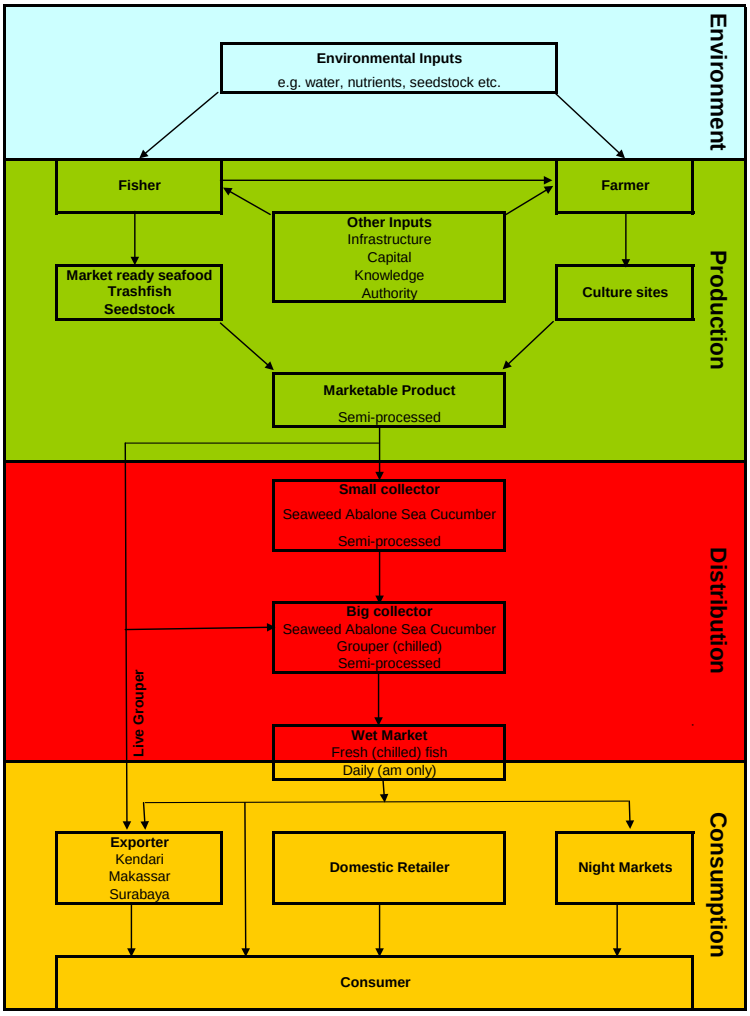
The mariculture farming systems in SE Sulawesi also provide a good opportunity to introduce "Better Management Practices (BMPs)' as had been done with commodities (Umesh *et al*., 2007) elsewhere, with encouraging results. The adoption of BMPs has lead to an improvement in overall production, reduced disease occurrence and better market access and farm gate prices, the latter being often an Achilles heel for small-scale farmers in relatively remote localities.

Finally, studies along the value chain, as the current project is evaluating, will be useful to bring about a more coherent trade of the farmed products in the region. Such steps will eventually lead to better farm gate prices, and also adoption of better, ecologically acceptable farming practices. Specifically, the ACIAR scoping study is investigating a new conceptual framework for developing the existing mariculture industry in SE Sulawesi. This will feature strategies for transforming the existing supply chain into a more functional market chain, underpinned by enhanced stakeholder networks and associated information systems, marketing strategies, risk management and capacity building. A community-based approach to trophically balanced mariculture, integrating the environmental benefits of seaweed farming with production of higher value products, has the opportunity to adopt an effective and distinctive market brand for the province. This will require substantial changes to existing supply chain characteristics and functions, led by private sector 'chain champions' working across production, distribution and consumer sectors, and in partnership with government, IGO/NGOs and tertiary sectors. In the longer term, the livelihoods of those coastal communities in SE Sulawesi involved in the mariculture industry will benefit greatly if sustainable industry development can be achieved, noting of course the inevitable emerging challenges from climate change, biosecurity threats and market globalisation.

References

Umesh, N.R., 2007. Development and adoption of BMPs by self-help farmer groups. *Aquaculture Asia*, XII (1), 8-11

SE Sulawesi Mariculture Market Chain



Schematic summary of existing mariculture supply chain in Kendari Bay, SE Sulawesi with focus on grouper, sea cucumber, abalone, spiny lobster and seaweed

Assessing Mariculture Market Constraints and Potential in South-East Sulawesi
Stage 1 – Stakeholder Engagement & Situation Analysis

SMAR/2007/225

Conceptual Framework and Strategic Industry Development Plan for Mariculture in SE Sulawesi

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August 2009

Contents

Introduction

Background

The island of Sulawesi (38,139km2), with a coastal area of 114,879 km2 and a coastline of 1740km, is recognised by the government of Indonesia as a major area for development of mariculture. Within Sulawesi, one of the least developed areas is SE Sulawesi Province, which consists of 12 Districts, comprising ten regencies and two major urban centres, including Kendari which is the major population and commercial centre, and Bau Bau on Buton Island (Aslan *et. al.* 2008).

Seafood is a major Indonesian export and was 15% (US$ 1.6 billion) of agrifood exports in 2006, but SE Sulawesi exports < 0.1% of this total and only uses an estimated 6.3% of its available coastal area for development (ACIAR 2009). Having said that, fishery related activities are of importance to this Province and are currently estimated to be about 12% of annual GDP. Mariculture as a commercial enterprise is well established and contributes approximately 3-4% of the GDP estimate for fisheries, with most activity centred around the islands of Buton and Muna, and in the outer Kendari Bay area near Kendari city. In 2007, aquaculture production in the Province, including mariculture, reached 153,160 t, valued at approximately Rp 1000 billion, with an estimated >115,000 households and >160,140 persons involved (Aslan *et. al.* 2008). Major production to date (> 85%) has been primarily centred around farming of red seaweed, largely in response to increasing global market demand for raw materials, but a variety of other higher value products are presently being produced for local and export seafood markets in Sulawesi, Indonesia and the broader Asian region.

Although the legislative and regulatory framework designed in part to facilitate development of mariculture in Indonesia has been in place since the mid 1980s-early 1990s (ICMFSER 2009), it is apparent that most development has taken place within the last 5-7 years (Dinas Perikanan 2009). In order to encourage mariculture, for export as well as for increasing domestic consumption of seafood, the 'Aquaculture and Fisheries Revitalisation Initiative for East Indonesia' of the Government of Indonesia (GOI) is being implemented at the provincial level through the Dinas. Under this initiative, aquaculture products including shrimp, lobster, groupers, seaweed and sea cucumber have been targeted. The revitalisation initiative essentially consists of providing soft loans to small-scale farmers formed into groups of 5-10 individuals and provision of training, and aims to bring about institutional (farmer groups) empowerment. The average loan provided is in the order of Rp 5-6 million, and the farmers are expected to invest these funds in seed, netting and feed procurement, and improving cage infrastructure. For SE Sulawesi, Rp 1 billion has been made available by the GOI in 2008 for investment in 12 districts/towns throughout the province.

Apart from the GOI initiative, for the most part development to date appears to have been mostly opportunistic, somewhat ad hoc and fragmented, with little strategic industry or market focus. The consequence is that much latent potential remains untapped, with limited opportunity being realised for expansion, diversification and increased profitability; this at a time when the mariculture sector throughout the region faces major challenges from among other things, climate change, market globalisation, the global economic crisis and rapidly changing consumer preferences for higher value, quality assured seafood products for human consumption.

SADI and SMAR initiative

SE Sulawesi is a relatively impoverished region of Indonesia and the existing mariculture sector is made up of mostly smallholder producers and local collectors/traders living in rural coastal fishing villages around the extensive provincial coastline. There is presently great potential to enhance livelihoods for these smallholders through facilitating development of the mariculture industry in SE Sulawesi.

The Government of Indonesia, having recognised this fact, is in the process of initiating mariculture development activities in partnership with the Australian Government through the 'Smallholder Agribusiness Development Initiative' (SADI). The Australian Centre for International Agricultural Research (ACIAR) coordinates the 'Support for Market Driven Adaptive Research' (SMAR) sub-program of SADI.

The Present Study

The purpose of the present study was to:

- Undertake an analysis of the existing mariculture supply chain in SE Sulawesi, including environmental scanning of all relevant information, risk and opportunities
- Develop a conceptual framework for industry development, and
- Prepare a draft strategic industry development plan for mariculture in SE Sulawesi.

This study was undertaken as a key component of the ACIAR (SMAR) funded project entitled:

Assessing Mariculture Market Constraints and Potential in SE Sulawesi – Stage 1: Stakeholder Engagement and Situation Analysis (SMAR/2007/225)

This project has involved collaboration between Department of Primary Industries (DPI) (Australia) as the principal investigator, Faculty of Fisheries and Ocean Sciences at Haluoleo University (Univ. Halu) and Dinas Perikanan (Kendari, SE Sulawesi), Indonesian Centre for Marine and Fisheries Socio-Economic Research (ICMFSER) and Network of Aquaculture Centres in Asia-Pacific (NACA).

The environmental scanning process for the present study included data and information input from:

- Two project planning and stakeholder engagement workshops completed in Kendari, SE Sulawesi during January "08 and April "09
- Various field trips in and around Kendari/Kendari Bay during five project visits collectively by DPI and NACA project team members (June "07 – April "08)
- Various case studies, surveys and associated analyses and reports, including:
    - Seafood Market Supply Chain in SE Sulawesi - Morelink Asia Pacific (June 2008)
    - Institutional Framework for Fisheries and Aquaculture development in SE Sulawesi, Indonesia - ICMFSER (June, 2009)
    - Survey, Situation Analysis and Characterisation of the Mariculture Supply Chain in SE Sulawesi - Univ. Halu., ICMFSER, NACA and DPI (June, 2009)
    - Analysis of Mariculture Producer Networks in SE Sulawesi, Indonesia – Dinas Perikanan (June, 2009).
- Extensive consultation between the project team and local project partners, including the Dinas Kelautan Dan Perikanan, SE Sulawesi (Mr Hotman Hutauruk and staff), the Faculty of Fisheries and Marine Sciences, Haluoleo University, Kendari, SE Sulawesi (Dr Aslan Laode and staff) and the Indonesian Centre for Marine and Fisheries Socio-Economic Research (ICMFSER) (Dr Armen Zulham).

Industry Development Strategy

An industry development strategy for the mariculture sector in SE Sulawesi will assist industry to explore concepts, identify risks and opportunities, prioritise and schedule key needs and associated tasks, set targets and goals and otherwise provide a formal vehicle to engage stakeholders, including industry, government, service providers and investors in relation to such issues as:

- Organisation and management: Considers the information and communication requirements for key industry networks and linkages between industry participants and attraction of competent leaders ('chain champions'), producers, traders, investors and service providers.
- Market planning and development: Refers to such issues as joint marketing and marketing alliances, distribution alliances, better integration of primary producers, processors and exporters and the development of strategic marketing plans.
- Primary production supply, growth and profitability: Requirements to determine and implement improved production and post-harvest practices in the form of Better Management Practices.
- Quality assurance systems: The development and implementation of appropriate 'through chain' QA/QC systems, food safety and traceability to meet market needs and expectations.
- Research, Development and Extension (R, D & E) and training: Requirements for market chain members to enhance productivity, profitability and sustainability through access to new technologies and to standardised training programs are issues for consideration.
- Investment: Framework for lobbying for Government and aid program support and for attracting new capital investment for infrastructure, capacity building, market development etc.

To achieve these outcomes, the industry development strategy should have a clear vision and be based on SMART goals (Strategic Measurable Achievable Realistic Timely) goals owned and supported by key stakeholders, with an agreed work plan incorporating prioritised actions and a timetable for addressing short, medium and long term objectives and outcomes.

The industry development strategy should remain in draft format at least initially until all stakeholders are consulted and feedback provided, after which it can be finalised and implemented as a Stage I/II plan. The strategy needs to be reviewed and revised as appropriate at least every three years thereafter to ensure it remains on track to achieve stated outcomes.

A tentative vision for development of the mariculture industry in SE Sulawesi is:

To be a significant and sustainable primary industry supporting social, economic and environmental wellbeing of coastal communities throughout the Province

To realise this vision, the following key development goals are proposed for initial consideration:

<u>High Level (long term)</u>

- The mariculture industry to develop through an agribusiness-based, market-driven approach
- Smallholder, business and institutional capacity enables the realisation of industry potential and flow of through chain benefits

Low Level (short-medium term)

- Development is supported by producer networks and associated integrated businesses employing Better Management Practices
- Development is supported by targeted, industry-based RD&E and skills-based training
- Development is supported by structured investment, market development and marketing plans

These goals also implicitly indentify the broad scale practice changes that are required from industry and key stakeholders, as well as the expected knowledge, attitudes, aspirations and skills that are likely to become apparent.

Key Result Areas and associated performance indicators to determine progress in meeting these goals are yet to be determined, but may include:

- Validated production, pricing, yield and profitability data for mariculture sectors/products
- Producer association registrations, start-ups, communications, enquiries and feedback
- Compliance with and performance of agreed Better Management Practices
- Market/buyer demand, trends and specifications
- Through chain infrastructure and investment trends, registered businesses and start-ups
- Registered training courses, enrolments and qualifications
- RD&E outputs, publications, manuals, services and IP commercialisation.

The primary 'end users' and beneficiaries of the proposed mariculture industry development strategy for SE Sulawesi include:

- Smallholder farmers, fishers and local traders
- Coastal communities
- Other chain participants
- Provincial and regional institutions (tertiary and government)

Situation Analysis

A mapping survey, situation analysis and characterisation study of the mariculture supply chain in SE Sulawesi (Univ. Halu. *et al*. 2009), together with GIS mapping of location and geo-physical attributes of existing mariculture activities, have been completed as part of ACIAR Project SMAR/2007/225, concurrent with the present study. These studies described the existing supply chain in terms of the key product-based sectors, the major components and linkages within the chain, pricing and cost-benefit indicators, and general characteristics, risks, opportunities and recommendations for future development.

It is clear from this work that the mariculture supply chain in SE Sulawesi is equally dependent on the input of mostly smallholder producers (fishers and farmers) and local traders, as well as more financially substantial inter-island traders for accessing a combination of domestic and export markets. It is equally apparent that there is considerable potential for expanding the production of staple products such as farmed seaweed, together with a variety of existing and emerging higher value products. There are a number of risks and constraints that have been identified through the environmental scanning process which need to be managed and/or overcome in order for this potential to be realised. There is a high likelihood of social and economic benefits which would flow to the mariculture sector participants if this can be achieved. At the present time, such benefits disproportionately favour the post harvest, distribution end of the supply chain, with smallholder producers gaining relatively minimal benefits.

Development of the industry needs to be underpinned by strategic planning to facilitate effective and efficient transition from the existing situation to a more sustainable, preferred outcome.

The Products

The 'marquise' seafood products providing the focus for the present study and for the industry development strategy were identified by local stakeholders in the initial project planning workshop held in Kendari, in January 2008. These products include a combination of established and emerging species which are endemic to the region and have either be adapted for mariculture through adoption of 'controlled' production technologies, or are presently wild-fishery based with potential for adaptation to mariculture as market demand increases and the natural resource base comes under increased pressure. The species are described collectively by Aslan *et al* 2008 and Univ. Halu. *et al.* 2009, with the latter also describing the existing supply chains and markets.

The major mariculture sector is the production of red seaweed, *Kappaphycus (*also referred to as *Eucheuma) cottonii*, which is predominantly sold by farmers to village and inter-island traders as a relatively low value, semi-dried raw material. The traders consolidate and on-sell the raw material to processors in Surabaya and Jakarta for extracting carrageenan-based food-grade thickeners for use in processed food and other manufactured consumer goods in Indonesia and various export markets.

In addition to seaweed, there are a number of relatively higher value mariculture products being generated out of SE Sulawesi, including spiny lobster (*Panuliris versicolor*), various grouper species (*Epinephelus* spp. and *Cromileptes* sp.) and pearl oysters (*Pinctatda maxima*). The wild catch fisheries sector in SE Sulawesi also has a number of high value species which have potential for value-adding through adoption of mariculture practices to cultivate wild-caught seedstock (juveniles and sub-market size sub-adults), such as sea cucumber (*Holothuria* spp., including *H. scabra*, and *Stichopus* spp.) and abalone (*Haliotis asinina* and *H. varia*). The wild catch sector also provides substantial feed resources to the mariculture sector through production of small, inshore, multi species trash fish to feed higher values species typically under pen and/or cage culture (Univ. Halu. et al 2009; Dinas et al).

Estimates of annual production data and value for the mariculture sector and specific products are provided in more detail in Dinas Perikanan (2009) and Univ. Halu *et al.* 2009.

Industry 'Chain' Concepts

The industry development strategy discussed in this paper is focussed on the combination of seaweed as a staple, and a nominal selection of higher value products as previously described. There are other valuable products with considerable potential, including various other finfish, crab and shellfish species, sea urchins and ornamental fish. These other products are not dealt with specifically in this project, but the broader industry and market development imperatives described in this report are relevant to realising the potential of these products in future years.

In the context of industry development, the collective term 'chain' refers concepts describing the sequential set of commercial, primary production mariculture activities or operations beginning with the supply of raw materials and terminating with the sale of the finished product. In the context of the present study, the supply-demand dynamic is progressively reproduced on multiple occasions in various forms in different mariculture and related fisheries sectors through what is commonly referred to as a supply chain. More recently the well established agribusiness or market-based approach to developing supply chains (otherwise referred to as 'market chains' in the present study) into 'value chains' is primarily

distinguished by the creation and delivery of value between each step of the chain, driven by the needs of the consumer or customer. Businesses within a chain generally strive to achieve a competitive advantage within the market place. A robust chain can be a competitive advantage in itself, whereby the chain as a mechanism can compete with other chains.

Supply chain mapping of the mariculture industry in SE Sulawesi has not previously been described. Indeed there is limited recent information describing small scale and/or low value aquaculture supply chains in SE Asia in general. De Silva (2008) described supply chains for mostly freshwater fish in country-based case studies including Myanmar, Vietnam, Thailand, India and Lao PDR. This study highlighted the importance of relatively low value cultured commodities in terms of absolute value/tonnage, impacts on rural development, food security and contribution to poverty alleviation. The study also contributes to the knowledge gap in respect of marketing for such commodities. Although referring to different species and, apart from farmed seaweed, to lower unit-priced products, the findings of this study are instructive and conceptually consistent with the aspects of the present study. The reference by De Silva (2008) to low value trash fish as a key feed source for marine farming is particularly relevant to the mariculture industry in SE Sulawesi and to the present study. De Silva (2008) notes the recent emergence of export markets for new and existing aquaculture commodities, cautions against the risk of intensification beyond natural carrying capacity in order to meet increased demand, and encourages scientific studies designed to recognise and work within environmental limitations. De Silva (2008) makes particular reference to the need for further investigating and developing supply chains for low value species including farmed seaweed, noting the current significant levels of seaweed production, gross economic value and its importance in encouraging female participation in the workforce and in supporting smallholder enterprise and associated households in many low-income, food-deficit Asia-Pacific countries.

Through Chain Development

Staged Development Approach

For the purposes of this study, a three staged industry development strategy is proposed, with a primary 'through chain' focus based on the following timeframes and nominal descriptors:

- Stage I - Present – Semi-Functional Supply Chain
- Stage II - next 3-5 yrs – Functional Market Chain
- Stage III - >5-10 yrs – Value Chain

The present, Stage I 'semi-functional' supply chain (Fig. 1) is so described based on the outcomes of the environmental scanning undertaken as part of this study (see also Univ. Halu. *et. al.* (2009)). The existing supply chain is established, operational and economically viable, but profitability is variable and disproportionate across sectors and probably therefore not viable in the longer term. Producers are 'price takers' rather than 'price makers', thereby subject to the vagaries of fluctuating market demand with limited ability to optimise recurrent expenditure, revenue and overall profitability. Producers typically place little premium on product quality beyond the needs of the next step in the chain. In most cases they are unaware of end consumer needs and associated market requirements, other than what is dictated by the traders. This is a disincentive for investment, expansion and diversification by the producers. Although existing practices are largely traditional and consistent throughout the Province, there is also no accepted benchmark for production techniques, product quality or environmental management. In the absence of adopting a more systematic and agribusiness approach to development, livelihood of producers remains mostly impoverished and considerable potential remains unrealised. To break the status quo, industry development

requires an investment in capacity building, production, communication/information systems and post-harvest infrastructure, resource management and a strategic market focus.

Stage II is proposed as the first step in progressing from the existing supply chain scenario to a more functional market chain over the next 3-5 years. This is seen as the immediate priority for the industry, but with an aspirational goal of subsequently developing a true 'value chain' in the longer term as Stage III (realistically, given existing circumstances, unlikely within the next 5-10 years).

A Stage II Functional Market Chain (Fig. 2) is characterised by most sectors being established on agribusiness principles of management and development, typically featuring strong, strategically-based partnerships or networks with more integrated and streamlined planning, production, trading and marketing processes. These partnerships or networks would be led and/or coordinated and managed by designated 'chain champions' and provide a platform for development, demonstration and implementation of standardised Better Management Practices (BMPs). Market information systems would be established and operational for much of the chain, allowing pricing, quality and profitability to be enhanced. This would provide the basis for a more informed, strategic expansion in overall production of existing products and diversification into new products as appropriate, together with necessary market-driven incentive for changing established practices. Higher value and quality products would begin to be differentiated in the market place with the assistance of BMPs to underpin quality control, productivity improvement and environmental management. Enhanced technical capacity and infrastructure at all stages would be under active development and expansion, as evident from combined government and private sector investment.

Achieving Stage III Value Chain status would be characterised by these Stage II market chain features becoming embedded within the sector, resulting in more equitable sharing of market information and influence and more proportionate sharing of the intrinsic value of the products between all participants through the chain. The chain would operate in a more seamless fashion based on fully integrated (vertically and horizontally) business partnerships or alignments. Market information, particularly price, quantity and standardised QAQC specifications would be provided routinely and in a timely matter, where possible with pricing negotiated transparently, in advance and confirmed in binding forward purchase agreements. Under this scenario, all participants in the value chain, including producers and traders alike, have a shared stakeholding in maintaining product pricing, supply and quality throughout the entire chain to the end consumer, rather than just between specific links. The industry would be fully developed and managed on an ecologically sustainable basis, with an internationally recognised regional brand, conforming with market-based and fully traceable QAQC certification systems customised to meet through-chain market specifications, emphasising the holistic systems approach to mariculture in the region. To achieve this, the issues identified with the existing supply chain need to be addressed in the first instance, as proposed in Stage II, with measurable evidence of long-term, sustainable impacts.

Phase 1 (semi-functional) SE Sulawesi Mariculture Supply Chain

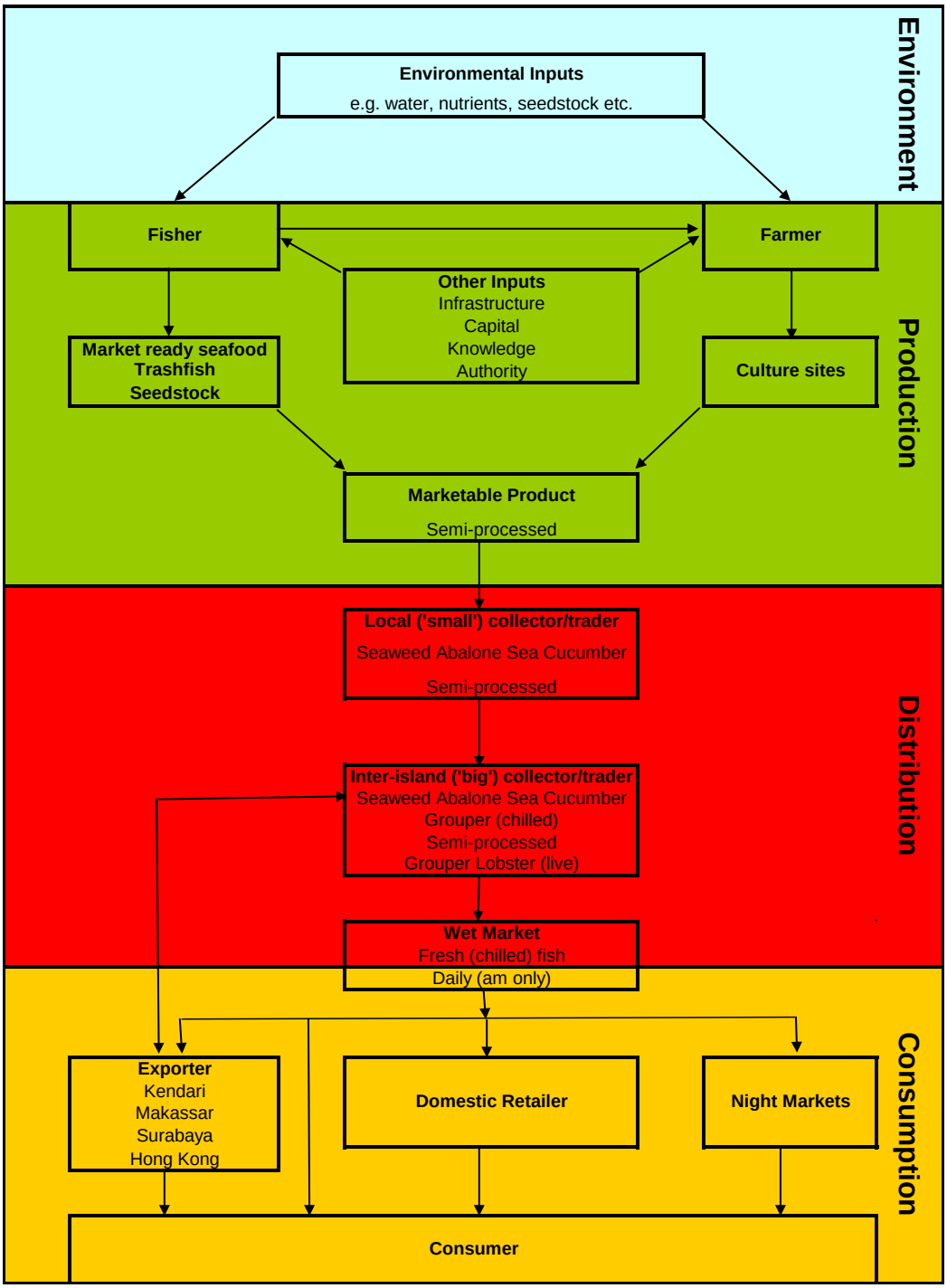

Figure 1. Schematic summary of existing 'Phase 1' (semi-functional) supply chain for mariculture industry in SE Sulawesi.

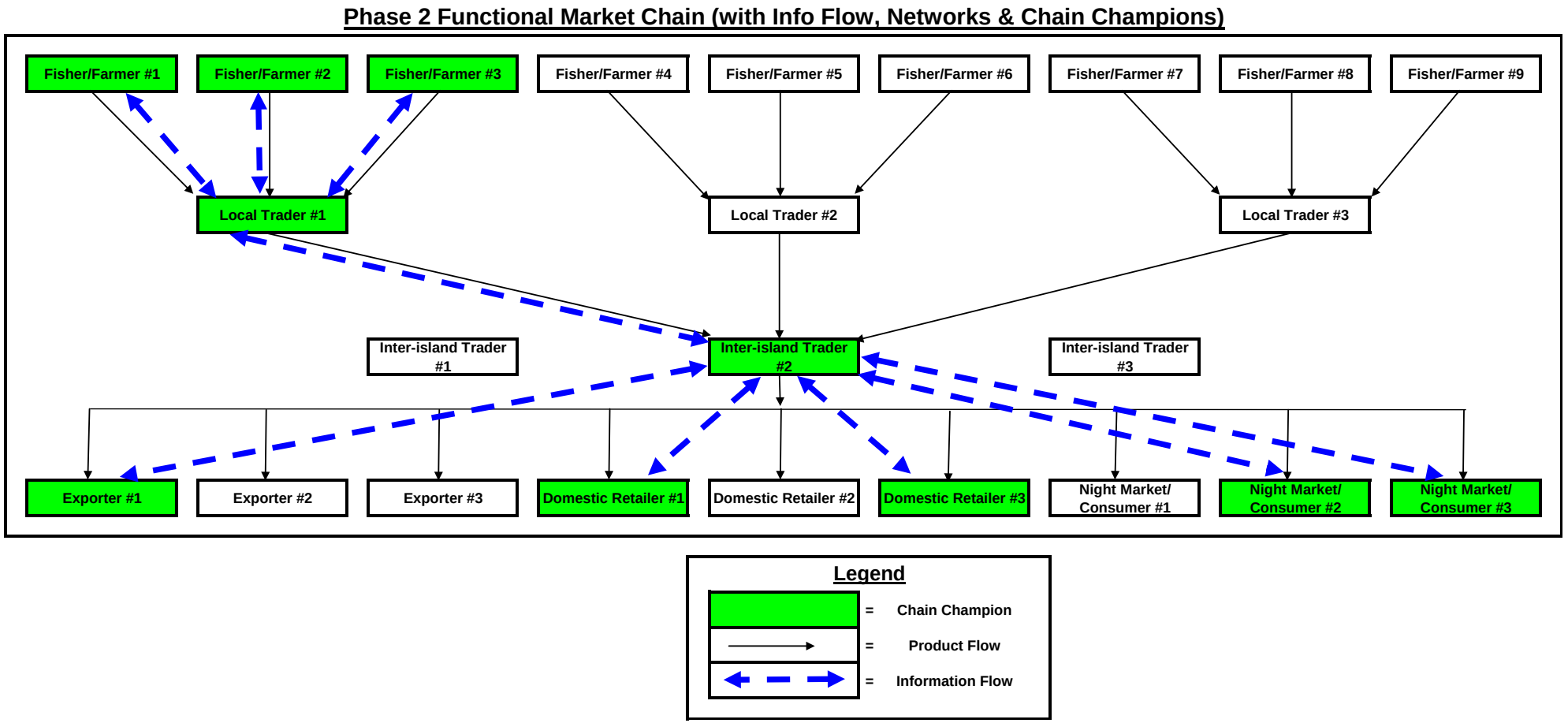

Figure 2. Schematic summary of proposed 'Phase II' (functional) market chain for mariculture industry in SE Sulawesi

Moving from Supply (Stg I) to Market Chain (Stg II)

The existing mariculture and inshore fisheries supply chain in SE Sulawesi is characterised by multiple product-based supply chains with potential for development, ranging from relatively low-value seaweed to higher value grouper, pearl oyster, lobster, abalone and sea cucumber, all destined for various local and export markets. In developing a market chain approach from the existing, semi-functional supply chain arrangements, consideration should be given to logical grouping of these supply chains, or parts thereof, based on value, market, geographical proximity and logistics. Reasons for this include:

- Product differentiation - Need for differentiation between commodities and products in the market place. For example seaweed is a relatively low value product sold as a raw material for processing and extraction of higher value by-products. Trade in farmed seaweed therefore has substantially different drivers, barriers and opportunities compared with the other, higher value products which require little or no processing and are sold direct to typically middle class consumers. Product segmentation provides the ability to add value to higher value products but at the same time provides opportunities for creative branding to leverage market demand, if not pricing, on all 'linked' products (same producer, production locality, natural resource base, business ethic etc) distributed through the same market chain.
- Market segmentation - Different businesses and individuals may operate in the various supply chains, at least for producers and local collectors/traders in the three key production areas. Although some inter-island traders tend to work across multiple sectors, others (e.g. pearl oysters) are very specific. Recognising the differences and similarities between the way businesses and individuals operate creates opportunities for effective market segmentation whereby available resources can be consolidated to achieve maximum effect in overall profitability. Knowing when to cooperate in order to better compete is a key criterion for business success in a more functional market chain scenario. Similar supply chains and those with commonalities of operators, logistics and technologies face similar challenges in the marketplace, and similar techniques may therefore be used to more cost-effectively improve efficiencies and overall performance and profitability in the supply chain.

Before any industry development strategy is considered for the mariculture sector in SE Sulawesi there are some additional steps which need to be addressed:

- Identification of 'chain champions' or individuals within the chain that will take carriage of market chain methodologies and practice change through development and adoption of BMPs required to drive gains in efficiencies and profitability. These individuals are key to the success of the development strategy and must retain ownership over an agreed period for recommended changes in order to develop a culture of cooperation and self reliance within the emerging market chain.
- Development of key industry/government market chain relationships. Successful implementation of recommendations concerning market chain development requires understanding, trust and complete, reliable and timely information from all stakeholders. Such a relationship can only be gained by establishing and maintaining constructive dialogue and demonstrating practical commitment in terms of proof-of-concepts for new ideas, usefulness and reliability of information etc.
- Motivate involvement of as much of the supply chain as possible, particularly the producers and local traders, as they are the chain participants identified as being the most disadvantaged in the present chain structure. The majority of the primary producers (preferably >75%) and key up-stream traders are required to 'partner up' in order to successfully implement stepwise change in supply chain practices in order to achieve more functional, market chain status.

- A detailed review and audit of existing quality assurance/quality control (QA/QC) systems, to the extent that they exist in any form presently and/or are required by buyers to secure market access, will identify risks and opportunities according to specific products and markets. In the longer term this will facilitate more targeted training and certification programs to better align them with 'best practice standards'.
- A 'consumer and competitor' market analysis, specific for each of the key mariculture products of interest, and including identification of market chain drivers and barriers to change, would provide existing supply chain participants with vital information which is presently lacking about who the final consumers of their products are, what are their needs and who they are competing against to meet these needs. A 'barrier' can be considered as a factor that works against change and a 'driver' is considered to be a factor that promotes a successful change in behaviour. This information then needs to be updated and communicated regularly to chain participants, and a number of frameworks and tools[1] may then be utilised to promote change and influence individuals associated in value chains. In the absence of such critical information, existing supply chains will remain 'semi-functional', thereby unable to achieve more functional, market chain status.

Some of the tools to promote change are described in but not limited to:

Assael (2004) Consumer Behaviour. A Strategic Approach. Published by Houghton Mifflin Company, Boston, MA, USA. Pp. 30-31, 218-219.

Binney, W., Hall, J. and Shaw M (2003) A further development in social marketing: Application of the MOA framework and behavioural implications. Vol 3 (3) : pp 387-403.

Davies (2003) Drivers for Change in modern Food Supply. Global Food safety Seminar Series, AFFA/NFIS.

Rothschild (1999) 'Carrots, Sticks and Promises: A conceptual framework for the management of public health and social issues behaviour', Journal of Marketing 63 (10): 24-37.

Johnson F. and Linehan, C (2005) Linking policy and practice to achieve outcomes. Department of Primary Industries. Pp. 2-3.

Johnson F. and Linehan, C (1999) Using a change framework to design a change program – adoption of water use efficiency improvements in the dairy industry. Department of Natural Resources and Environment, Internal document.

Kearnes, B (2005) Barriers and drivers to systems uptake in agri-food value chains & strategies for effective implementation of practice change. An Our Rural Landscape project Sub-Project 3.2: Route to Market. Department of Primary Industries, Melbourne

Role of Farmer Associations and Business Networks

In conjunction with the work detailed above, appropriate business networks incorporating farmer associations, and based on standard 'integrated' industry models should be considered. To this end, the existing farmer and fisher groups in SE Sulawesi and associated recommendations by Dinas Perikanan (2009) are instructive for future establishment of mariculture market chain business networks in the Province, and to facilitate capacity building through extension, training, marketing and infrastructure investment.

Development of an appropriate business network model based on farmer associations can assist industry develop a culture of cooperation, risk management, self-reliance and trust within the stakeholder groups. These networks can be expanded to include traders at different levels within the chain, and can facilitate through chain practice change. As communication and transparency between members is improved, it is expected that the existing supply chain can become a more functional and responsive market chain (Stage II) resulting. Networks also provide a vehicle for encouraging new industry entrants and existing primary producers to become better engaged and informed in relation to all aspects of their business.

Business networks have become part of industry culture within developed countries over the past decade, and the philosophy of 'co-operating to compete' is rapidly gaining momentum in the primary industries (including seafood) sector. Forming business networks is a proven way to give small to medium enterprise the ability to be competitive without bearing all the risks, costs and resource commitments of going it alone.

Business networks usually generate one or more of the following benefits:

- Consolidate individual business strengths
- Add value to their current operations
- Expand markets
- Share experiences, information and market intelligence
- Identify and develop niche markets
- Implement common business standards (e.g. in BMPs, customer service and quality assurance)

The benefits are derived through collaboration with one or more of the following activities:

- Marketing
- Sales
- Research and development
- Procurement
- Production
- Distribution

There are five main variations in types of networks. They are

1. Formal horizontal networks (Fig. 1)
2. Formal vertical networks (Fig. 2)
3. Joint action groups
4. Joint procurement networks
5. Export focussed international networks.

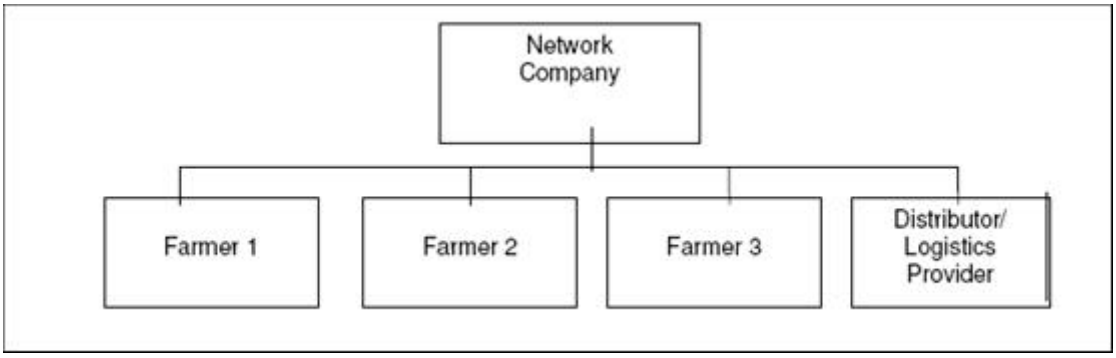

Figure 3. Simple horizontal business network

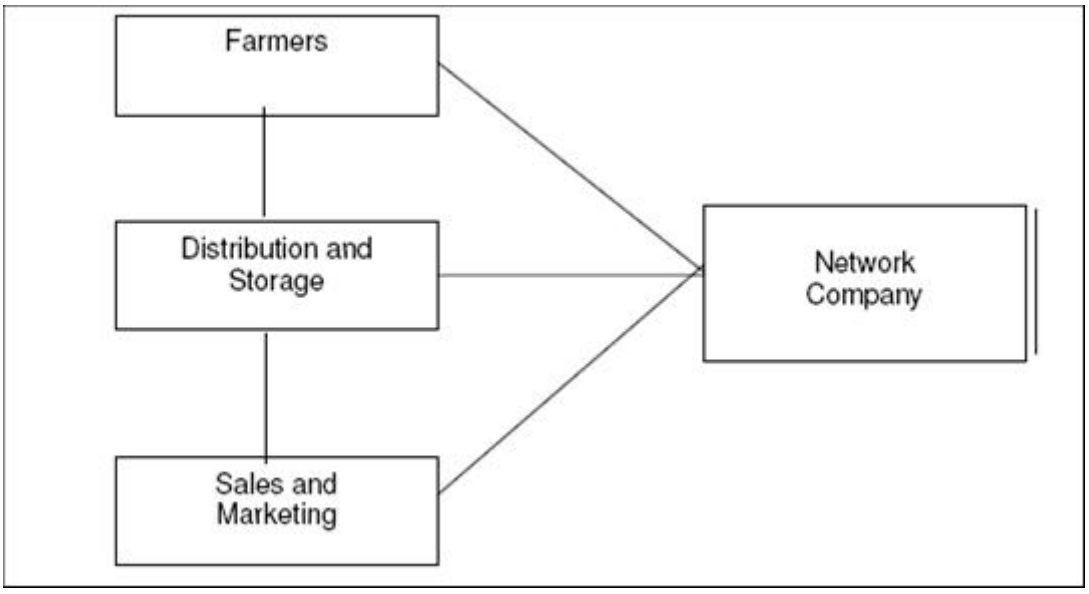

Figure 4. Simple vertical business network

Following successful development of an industry network, industry proponents are better positioned to think of the industry holistically, to some degree separate from their own immediate business concerns. Once stakeholders are thinking in this space they are better equipped to engage in the processes necessary for the implementation of an industry development and associated marketing strategy. A key role for the associations would be to facilitate development, demonstration and adoption of Better Management Practices (BMPs) throughout the key industry sectors.

Mariculture Marketing Strategy

A priority action for the SE Sulawesi mariculture industry development strategy is the preparation of a complementary marketing plan. This plan requires the input of all local mariculture industry stakeholders, but is best facilitated by an appropriately qualified seafood marketing consultant. The strategy will need to establish a market chain 'brand' which not only differentiates relevant products as value-for-money, but does so in part by characterising the SE Sulawesi region as a leading production area in Indonesia. Such status should be based on having abundant, pristine natural resources to draw on, which are managed within an ecosystem-based approach, thereby assuring premium quality and environmental sustainability. The brand would also initially feature the application of BMPs designed to highlight product, producer and environmental attributes.

Not only does this provide a marketing advantage for securing market access, it also supports optimal and sustainable development and expansion of the industry within natural carrying capacity limits, and provides a framework for ensuring that other terrestrial and aquatic catchment development is managed for sustainable, multiple use of resources. As consumer demands dictate and industry capacity is enhanced, new market opportunities will emerge through establishment of QAQC-based traceability and associated certification systems, which build on the established BMPs, to validate food safety and credence characteristics of mariculture products from SE Sulawesi.

Ecosystem-Based Natural Resource Management Strategy

The proposed ecosystem-based management approach should incorporate a conceptual framework which emphasises the inherent trophic balance achieved between the relevant production components, typically co-located within designated production areas. The latter need to be identified based on various criteria designed to optimise productivity (e.g. access, water quality, temperature, depth, tidal exchange) and minimal risk of impacts from contaminants, theft and disturbance from other users. Such criteria are readily able to be incorporated into an agreed integrated marine resource management planning scheme which would need to be developed and monitored on a cooperative basis by both national and provincial government agencies and relevant NGOs as appropriate. There is no such management planning in place at the present time in SE Sulawesi, and this requirement needs priority consideration by relevant agencies and industry alike.

As a net 'consumer' of nutrients, the existing low trophic level, seaweed farming sector provides an excellent platform for industry to offset environmental impacts from expanding into higher value, higher trophic level production of carnivorous grouper and lobster. High value products, sea cucumber, abalone and pearl oyster, are considered to be moderately benign from an environmental perspective, to the extent that they also feed relatively low in the food chain. Pearl oysters are filter feeders reliant on natural primary productivity of plankton in the water column. Sea cucumber is a detritivore which scavenges on benthic organic material, and abalone are herbivores and consume algae, including red seaweed when in captivity.

The conceptual framework for trophically-balanced, ecosystem-based aquaculture management, also referred to as 'integrated multi-trophic aquaculture' (IMTA) proposed for the mariculture sector in SE Sulawesi is schematically represented in Fig. 5 as part of what is considered a defining characteristic of the aspirational (Stage III) 'value chain' development outcome. Trophic balance refers to the incorporation of species from different trophic or nutritional/bio-energetic levels in the same production system. IMTA is a practice in which the by-products or wastes of one species/trophic level are recycled to become inputs (nutrients, food) of another species/trophic level. Actively fed species (e.g. grouper, lobster and abalone) are systematically combined in close proximity with inorganic (e.g. seaweed) and/or organic (e.g. sea cucumber and pearl oyster) extractive aquaculture to create balanced systems for environmental sustainability (biomitigation), economic stability (product diversification and risk reduction) and social acceptability (better management practices) (www.wikipedia.org). This concept is also described in more detail by Troell *et al.* (2003) Neori *et al.* (2004), Ridler *et al.* 2007 and Gooley and Gavine (2003), the latter in the context of integrated agri-aquaculture systems development in Australia. To what extent an IMTA or similar outcome is considered realistic for SE Sulawesi is largely dependent on whether all stakeholders will support the strategy for progression to Stage II in the first instance, and will commit the requisite resources for implementation of key actions identified in this document.

Another dimension to the IMTA approach which may be adapted for SE Sulawesi is that it is compatible with the existing community-based, coastal village structure characteristic of the industry in outer Kendari Bay, and Buton and Muna islands. This approach recognises the importance of relatively low capital, low-input mariculture enterprise to the social and economic viability of these often isolated and impoverished coastal communities (see also De Silva 2008). A mariculture industry development strategy that has an embedded coastal community development imperative, which places a premium on enhancing social capital and which draws on the inherent resourcefulness and innovation of the local residents with the potential reward of improved living standards has a strong likelihood of success in SE Sulawesi.

Edwards (2007) refers to a preferred 'agro-ecosystem' approach to achieving sustainable aquaculture development for resource poor rural communities in developing countries, in the context of describing aquaculture as a physical system nested in a hierarchy of systems from organism, through enterprise and farm, to community, region, nation etc. More specifically, Edwards (2007) indicates that aquaculture farming systems need to be analysed in relation to the specific farming system and its physical/biological, socio-cultural and policy/institutional environments, and that this totality of understanding should be used as the basis for development to improve people' welfare. The broad principles of the associated participatory Farming Systems Research and Extension approach defined by Edwards (2007) complement the conceptual framework and the underlying principles of the draft industry development strategy proposed for mariculture in SE Sulawesi (this report). This approach dictates the need for interdisciplinary sciences working in partnership with smallholders, other stakeholders and service providers to:

- Assess needs and resources of smallholder households
- Identify and test appropriate technologies
- Analyse and monitor extension options for delivering new technologies

The schematic summary description of a SE Sulawesi mariculture Stage III value chain based on an IMTA framework in Fig. 5, includes arrows which are indicative of the flow and/or exchange of:

- ecosystem services from natural landscape to production landscape
- external impacts (e.g. wastes) from production landscape to natural landscape
- inputs and outputs between different levels of production landscape
- movement of products, economic value and market information through chain between production, distribution and consumer landscapes.

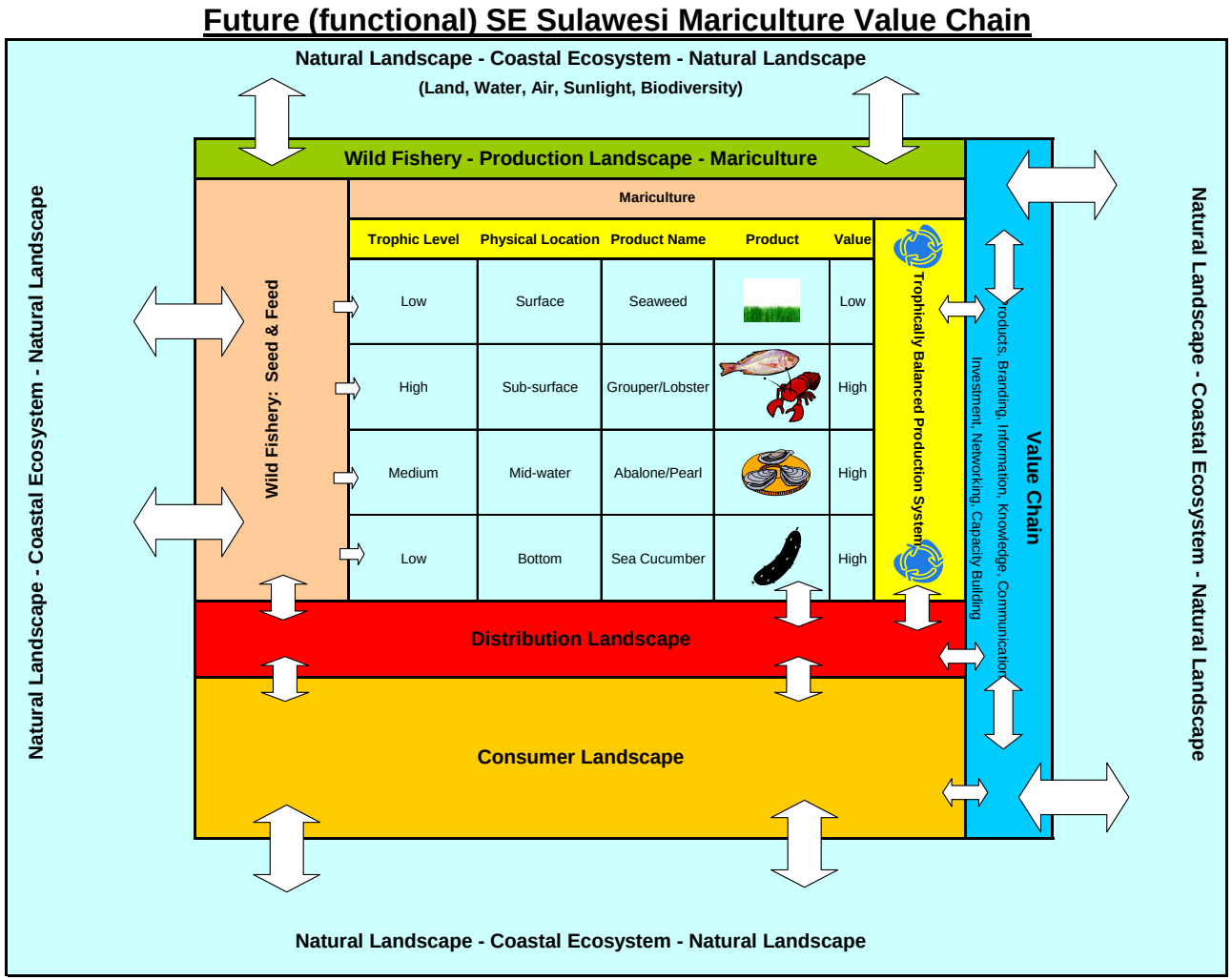

Figure 5. Schematic summary of proposed 'Phase III' value chain for mariculture industry in SE Sulawesi, incorporating IMTA conceptual management and development framework.

Financial Resources and Investment

Implementation of the proposed industry development strategy will require substantial new financial resources to be invested at all levels of the chain by both government and industry alike. Private sector finance is available in some areas, but present indications are that micro-financing of small holder fishers and mariculture producers in SE Sulawesi is inadequate in most areas to achieve substantive industry growth. In many areas, producers are reluctant to access available private sector funds due to prohibitive terms. In other areas, micro-financing arrangements managed by traders and other local private financiers perpetuate low-income scenarios and serve as a disincentive to risk taking and associated expansion and diversification by smallholders. More 'benevolent' private capital needs to be identified through encouraging joint venture partnerships between existing producers and offshore or otherwise new industry investors such as the International Finance Corporation (IFC), as an adjunct to existing sources of private capital.

The IFC is a member of the World Bank (www.ifc.org) and fosters sustainable economic growth in developing countries by financing private sector investment, mobilizing capital in the international financial markets, and providing advisory services to businesses and governments. IFC invests in enterprises majority-owned by the private sector throughout most developing countries in the world, including Indonesia. IFC has a priority for helping new SMEs in emerging markets create jobs, generate revenues, improve governance and environmental performance, and contribute to their local communities. The goal is to improve lives, especially for impoverished smallholders where the benefits of economic growth can be best realised. Services provided by IFC to support private sector agribusiness development include advice for access to finance, infrastructure development, corporate governance and business enabling and aspects of environmental and social sustainability. The industry development strategy needs to prioritise actions designed to formally engage the IFC and to formulate an appropriate investment strategy to underwrite costs associated with capacity building, infrastructure expansion, marketing, logistics, governance and environmental management.

R,D & E, Tech Transfer & Training

Establishing the existing mariculture sector on the basis of a functional market chain, as proposed by this industry development strategy, dictates the need for a parallel investment in and development of production and post-harvest (e.g. processing, handling, storage and logistics, marketing etc) technologies and associated capacity building in SE Sulawesi. Accordingly the complementary role of a structured and prioritised research, development and extension (R,D & E) plan for the industry is crucial to achieving sustainable and measurable success in the medium to longer term (i.e. Stage II and III). This plan needs to be further supported by targeted technical transfer and skills-based training in all relevant areas of the industry. In relation to production, key priorities include:

- Infrastructure and systems design
- Broodstock management and hatchery seedstock
- Husbandry and inventory management of standing crop
- Feed manufacturing and nutrition
- Health management and welfare

- Environmental monitoring and water quality
- Grading and harvesting
- Better Management Practices.

In relation to post-harvest, key priorities include:

- Processing and storage
- Packaging, portion control and value adding
- Transport and logistics
- Better Management Practices (incl. quality assurance/control and ultimately full traceability and certification)

In relation to general business management:

- Agribusiness development and networking
- Market development and marketing
- Financial management and general business administration

At a higher level, institutional capacity building needs to be supported as an enabling mechanism for the above, primarily at the university (e.g. Univ. Halu), NGO and/or inter-governmental level (e.g. NACA), and for facilitating development of management plans, monitoring systems, communication and networking systems, investment, collation and reporting of reliable statistics and governance systems for overall administration, primarily at the provincial (e.g. Dinas) government level.

Linkages to existing aid-funded programs in the region, including AusAid and ACIAR, need to be explored as a means of cost-effective service delivery. As an example, there is potential for linking up relevant industry sectors and service providers in SE Sulawesi with the ACIAR project being undertaken on spiny lobster aquaculture development in Indonesia (Lombok), Vietnam and Australia (FIS/2008/021). This project recognises the strong potential Indonesia has to develop a cage-based lobster mariculture industry based on growout of wild-caught lobster seed, as currently practiced in SE Sulawesi.

There is also an opportunity for linking proposed development of the mariculture industry in SE Sulawesi with developments emerging from other Australian aid0funded projects in the region. Specifically, the development of BMPs could be facilitated by application of learnings from the AusAid (CARD) funded project on development of BMPs for catfish aquaculture in the Mekong Delta, Vietnam. Additionally, this project has also identified the need for development of seafood value chain strategies in SE Asia generally, specifically including mariculture value chain development in SE Sulawesi as a priority case study.

An additional R&D opportunity exists with the recent establishment of the Univ. Halu abalone hatchery pilot project in outer Kendari Bay. This hatchery has been established as a teaching and R&D facility for students of the Fisheries and Ocean Sciences Faculty, and has developed and adapted intensive breeding and early life history production technologies for mass culture of endemic abalone species (*Haliotis* spp.). This hatchery is a potential source of hatchery seedstock for farmed abalone in SE Sulawesi once production capacity expands. It also has potential as a multi species hatchery through diversification into hatchery production of seedstock for

other species including sea cucumber, grouper and perhaps spiny lobster in the future. The hatchery also has potential as a skills-based training facility for farmers, as an adjunct to the core R&D function.

Risks to Development

Key risks to the successful implementation of the proposed mariculture industry development strategy for SE Sulawesi have been identified as part of the previously mentioned environmental scanning process undertaken as part of the present study. The key risks have been variously described in combination by Morelink (2008), Aslan *et al.* (2008), Dinas Perikanan (2009), ICMFSER (2009) and by Univ. Halu. *et al.* (2009). In summary they include (but are not limited to):

- Lack of strategic and overt agribusiness approach to development
- Excessively elongate and convoluted supply chains
- Disproportionate 'through chain' spread of value favouring distribution end of chain
- Limited business integration and networking within chains
- Lack of standardised Better Management Practices
- Limited business administration capacity at smallholder level and lack of effective administrative governance arrangements at industry level
- No identifiable chain champions or forum for promoting industry leaders
- Insufficient access to micro-finance, lack of apparent investment opportunities and overall inadequate financial management base
- Incomplete linkages with existing seafood logistics and post-harvest industry sectors
- Limited and poorly resourced networking between producers
- Limited government resourcing of industry planning, extension and training
- Incomplete and/or otherwise inadequate environmental planning, management and monitoring
- Lack of a regional marketing strategy and associated brand and market development
- Lack of a regional R, D & E, skills-based training and technology transfer strategy
- Inadequate production and post-harvest infrastructure
- Limited operational inputs for seed, feed and support services for stock health management

It is not the intention of the present study and this report to address each of these risks individually through formulation of specific risk mitigation and treatment plans. The industry is presently at the very early stages of development and subject to multiple, concurrent risks. In the face of limited resources, lack of a catalyst to stimulate action, and lack of an accessible and agreed forum to facilitate change, existing industry threats and weaknesses are presently being 'accommodated' by maintaining the status quo.

Recommendations

Given the latent potential of the industry in SE Sulawesi, it is clear that the province in general, and smallholders in particular, would gain considerable benefit to social and economic wellbeing through promoting selected market development opportunities and addressing associated key risks. Under the circumstances, the preferred approach is to 'bundle' the development and risk response into a pilot project designed to undertake a package of related activities on a pilot, commercial scale. Such a pilot project would develop, evaluate and demonstrate several village-based case studies designed to facilitate through chain practice change. According to the proposed industry development strategy, this would progress selected industry sectors in the first instance from the present Stage 1, semi-functional supply chain, to Stage II, functional market chain over a 3-5 yr period. Features of the case studies would be 1) the identification of designated chain champions and formation of village-based farmer association networks, 2) formal engagement of new entrants to partner and coinvest with existing chain participants to offset and underwrite costs going forward, and 3) development and implementation of Better Management Practices (BMPs) by industry as a means to facilitate improved productivity and market access.

An example might include partnering up with one or more existing seafood companies based in Kendari Bay that are presently focused primarily on the wild catch fishery for inputs, particularly deep water pelagic fishes. These companies, operating as chain champions, are likely to have spare storage, processing and transport capacity and access to existing export markets in which demand exceeds supply. These companies may also have more ready access to venture capital for investment in new production infrastructure and capacity building, and may be amenable to entering into forward purchase contracts to offset existing financial risks to smallholders. For smallholders to effectively engage with such partnerships, better organisational arrangements and enhanced capacity is required.

To facilitate implementation of the draft industry development strategy and associated conceptual framework outlined in this report, the following key recommendations are made:

Primary:

- Undertake a regional scale, 3-5 yr pilot project in SE Sulawesi to trial the development, evaluation and demonstration of selected mariculture market chain strategies and associated actions as a portfolio of specific case studies
- The pilot project to be coordinated and implemented under the direction of a new high level mariculture task force to be established in SE Sulawesi with joint representation by key industry and government stakeholders.

Secondary:

- The case studies to be undertaken concurrently in selected regions of Kendari Bay and Buton and Muna Islands with focus on selected supply chains for key 'marquise' products including seaweed, grouper, lobster, sea cucumber, abalone and pearl oyster

- The case studies to include:
    - Formation and implementation of village-based associations ('aquaclubs') of farmers, fishers and local traders, to be recognised by the Dinas as key industry forums for communication, training and general support
    - Identification of chain champions within such associations and elsewhere within chains, including inter-island traders and other industry stakeholders as appropriate (e.g. NGOs, investors, consultants etc)
    - Development of a regional marketing strategy and industry investment strategy to be undertaken by appropriately qualified consultant(s) under direction of key industry and government stakeholder working group including aquaclubs, chain champions, Dinas, Univ. Halu. and relevant NGOs and development agencies elsewhere within the provincial government of SE Sulawesi
    - Joint establishment by the Dinas and Univ. Halu. of a functional and cost-effective communications system to facilitate capacity building within aquaclubs and market intelligence for real time delivery of critical price, quantity, quality and logistical data
    - Joint establishment of a technical advisory group within the Univ. Halu. And the Dinas for coordination and delivery of the proposed R,D&E strategy
    - Drafting of a management plan for mariculture in SE Sulawesi which provides an aquatic ecosystem-based IMTA framework for development; to be developed by appropriately qualified consultants under direction of and in collaboration with a key industry and government stakeholder working group including Dinas, Univ. Halu., relevant NGOs and environmental management agencies elsewhere within the provincial government of SE Sulawesi, and aquaclubs and chain champions.
    - Development and trial demonstration of BMPs for selected industry sectors via newly established aquaclubs.

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- Dinas Kelautan Dan Perikanan, SE Sulawesi (Mr Hotman Hutauruk and staff), and
- Indonesian Centre for Marine and Fisheries Socio-Economic Research (ICMFSER) (Dr Armen Zulham) and Agency for Marine Affairs and Fisheries Research (Dr Fatuchri Sukadi).

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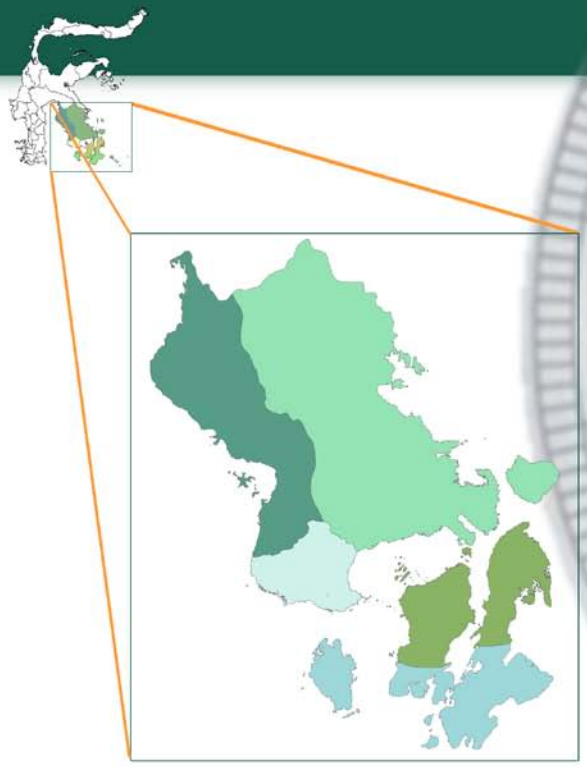
The authors also wish to acknowledge valuable input to the project provided by Mr Phillip Morey, Morelink Asia Pacific.



MAPPING OF EXISTING MARICULTURE ACTIVITIES IN SOUTHEAST SULAWESI: Potential, Current and Future Status







DEPARTEMEN KELAUTAN DAN PERIKANAN

ACIAR

UNIVERSITAS MALUKU

MAPPING OF EXISTING MARICULTURE ACTIVITIES

IN SOUTH-EAST SULAWESI:

Potential, Current and Future Status

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Supported by:

ACIAR/SMAR/2007/225
AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

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1 INTRODUCTION

1.1. Background

Market prospects and business opportunities for mariculture in South-East Sulawesi have not been optimally exploited thus far, although this region features a vast biodiversity of coastal natural resources along 1740 km of mostly under-developed coastline. In recent times, fisheries-based economic activities in this region have gradually been replaced by aquaculture due to degradation of natural coastal and marine fisheries resources. One example is the significant fish stock depletion in Wakatobi Regency, which has forced local government to initiate a fisheries management program to monitor and control fishing practices in the area (May and Coles 2004). SE Sulawesi Province is currently supporting mariculture as one of its long term development goals, as evidenced by programs such as pilot projects on abalone and grouper mariculture, and capacity building for seaweed farmers.

Among many cultured species in SE Sulawesi, grouper, sea cucumber, lobster, sea weed, pearl oyster and abalone are most favored by producers, with abalone in particular gaining popularity in the past ten years due to high market demand and price. Other species have also been cultured such as shrimp, crabs and other fish species. Most producers in SE Sulawesi use either traditional or semi-intensive mariculture techniques with limited inputs to increase final yield. A small number of well-established and well-funded producers have applied intensive mariculture systems to boost production and/or to culture high-value mariculture products such as grouper and pearl oyster.

Considering the potential area for development in SE Sulawesi under existing conditions, one lingering problem for the mariculture sector in this Province relates to the long and multi-levelled supply chain for products to reach consumers. This problem is aggravated by the limited access of producers to consumers, due to the geographic nature of the SE Sulawesi archipelago, and associated logistical, handling and communication issues.

The problematic supply chain is also characterized by the traditionally close relationship between producers and local middlemen (collectors, traders etc) for purposes of business engagement, but beyond which there is a lack of effective organization and information about mariculture production centres, product attributes and market needs. Such circumstances force the higher level middlemen (inter-island traders, exporters etc) to interact only with lower level middlemen, with little or know interaction with producers, resulting in products taking longer time to reach market destination. The consequences are significantly reduced quality and quantity of products, a through chain decrease in margins and profits, particularly at the smallholder producers level, and overall failure by the industry to realise full potential.

1.2. Present Study

The present study is part of a broader project funded by the Australian Centre for International Agricultural Research (ACIAR) entitled 'Assessing Mariculture Market Constraints and Potential in South-East Sulawesi' (SMAR/2007/225).

The objective of the present study was to map the existing status and geo-physical attributes of mariculture activities in the Province, including seed source, production and distribution of key species, practiced mariculture techniques, key water quality and other bio-physical parameters, as part of the broader ACIAR project survey designed to characterise the existing mariculture supply chain in SE Sulawesi. It is expected that this study will provide valuable information to key mariculture sector stakeholders, including business entities and individuals, government agencies, researchers and to the fish farmers themselves in order to develop sustainable yet profitable mariculture in SE Sulawesi. This allows for a better understanding of what industry development strategies are required to enhance functionality of the supply chain and improve overall profitability and sustainability of the sector. In particular, the improvement of livelihoods and overall wellbeing of smallholder producers is an expected medium-longer term outcome of the adoption of a more agribusiness approach to development of mariculture in this Province.

2 METHODS

2.1. Study Area

The present study was conducted within the region of South-East Sulawesi Province, and focused on the mapping of existing mariculture activities and related aspects in three regencies (Muna, South Konawe and Buton) and two municipalities (Kota Kendari and Kota Bau-bau) (Fig. 1).

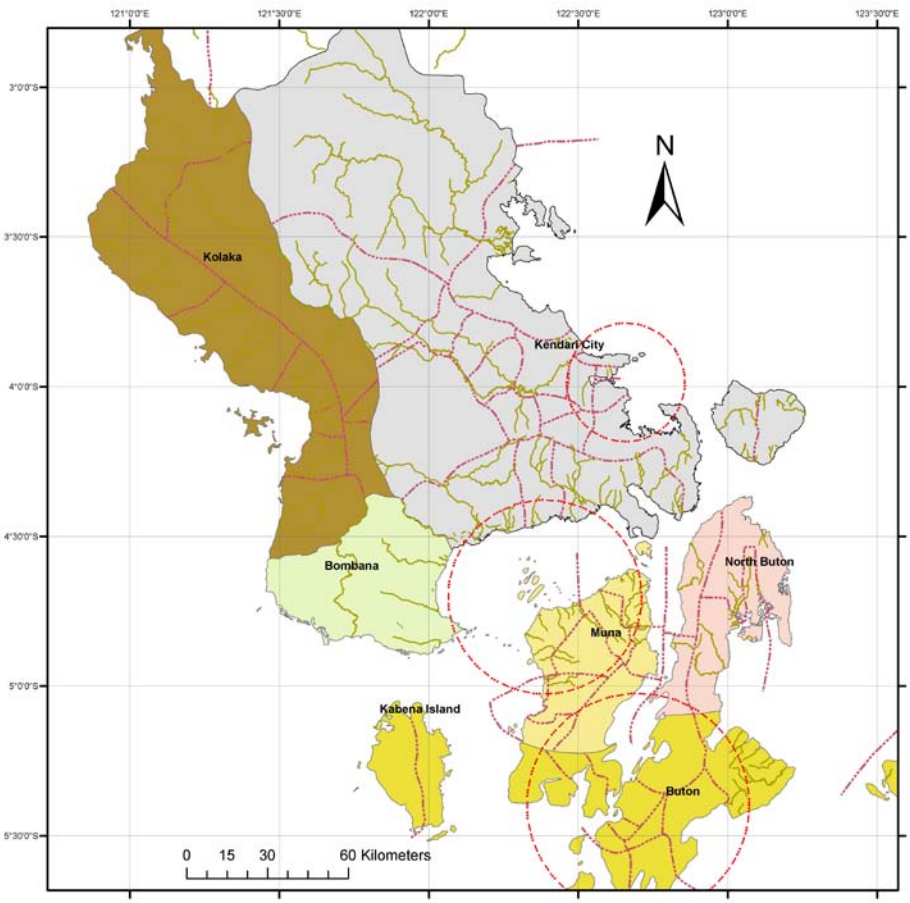


Figure 1. Map of Study Area (South-East Sulawesi)

The study location was chosen based on the identification of mariculture farmer groups as part of the broader ACIAR project (Dinas *et al.* 2009), where 47 villages were selected based on their significant contribution and potential to the mariculture development in the corresponding regencies. A list of surveyed villages grouped under their corresponding sub-districts and regencies is presented in Table 1.

Table 1. List of surveyed villages in South-East Sulawesi

No.	Regency	Sub-District	Village
A	Bau-Bau	Betoambari	Lamangga
			Sulaa
		Bungi	Palubusa
		Lea-Lea	Lowu-Lowu
		Kokaluna	Makassar Island
		Murhum	Bone-Bone
		Wolio	Batara Guru
			Wale
	Buton	Kapuntori	East Lambusango
			Kamelanta
			Tobea
		Lakudo	Boneoge
			Lolibu
			Waara
			Wajogu
		Mawasangka	Mawasangka
			Wakambangura
			Watolo
		Pasar Wajo	Kombeli
		Sampolawa	Katilombu
		Siompu	Karae
		Siotapina	Matanauwe
		South Lasalimu	Lasalimu
		Wabula	Holimombo
		West Siompu	Lalole
			Watuampara
B.	Kendari City	Abeli	Anggoeya
			Bungkutoko
			Lapulu
			Petoaha
			Sambuli
			Tondonggeu
		West Kendari	Kandai
C.	Muna	Duruka	Bonebalano
			Lagasa
		Guali	Tanjung Pinang
		Maginti	Bangko
			Gala Island
		Napabalo	Renda
		North Tiworo	Santiri (Balu Island)
			Tiga Island (Belo)
D.	South Konawe	Soropia	Bajo Indah
			Bokori
			Leppe
			Mekar
			Mekar Jaya
			Tapulaga

2.2. Data Collection

Data collection commenced on June 22, 2009 and lasted for 20 days. Spatial and attribute data of existing mariculture activities and key water quality parameters were the two main categories of the required data in this study.

2.2.1. Study Preparation

In order to minimise subjectivity and maintain data consistency, a set of open ended questions were prepared in the form of a questionnaire to be asked to potential interviewees. The questions were about the mariculture activities conducted by the interviewees, including farmer's details, technical aspects of practiced activities, post harvesting techniques and market availability. The other preparation that was made for this study was acquiring digital maps of the study area from Bakosurtanal (Coordinating Agency for National Mapping and Survey). These maps were 1999 Indonesian Digital Map and 1991 Topographical Map of Southeast Sulawesi Regencies. Some key spatial factors such as street, city location, harbor, administrative boundary and topographical contours were drawn from these maps, which then were refined using data from previous unrelated research conducted by some of the team members. Base maps were also prepared from these maps in guiding the field survey and assisting interviewees.

2.2.2. Spatial and Attribute Data Collection

Spatial and attribute data collection was performed to depict the distribution of existing mariculture activities and its related aspects. Location of mariculture activities were plotted using a handheld GARMIN GPS to record village location, and a GARMIN GPS MAP 298/278 was used to record location of fish farms and sampling stations of water quality parameters. Attribute data of the existing mariculture activities were acquired by interviewing fish farmers on location using the previously mentioned questionnaire. Interviewees were randomly selected from each location/village. One type of mariculture (i.e. grouper or abalone mariculture) was represented by one interviewee/fish farmer.

2.2.3. Water Quality Measurement

Key water quality parameters measured in this study consisted of temperature, dissolved oxygen (DO), pH, salinity, depth, clarity (Secchi depth) and turbidity. All of these parameters were measured *in situ.* A list of equipment used for *in situ* water quality measurements is provided in Table 2.

Table 2. List of measured water quality parameters in the study

Parameter	Equipment
Temperature	YSI 80 Digital Thermometer/ YSI 556
DO	YSI 80 Digital DO Meter / YSI 556
pH	YSI 60 Digital pH Meter
Salinity	ATAGO digital salinometer/ YSI 556
Turbidity	YSI 556
Depth	Calibrated rope/pole
Water clarity	Secchi disk

At every location, water quality parameters were measured using simple random sampling to determine the location of sampling stations (Clark & Hosking 1986). Water quality parameters were consistently measured during daylight hours from 09.00 AM to 03.00 PM to limit bias. Water quality data were then analyzed using IKA_STORET method (Centre, 1977) to depict the suitability of the location with the existing mariculture activities, and compared to the standard water quality parameter of the corresponding cultured species. According to Centre (1977) water quality condition is determined as ‘good’ if the total score of Storet value is between -1 and -10.

2.3. Data Analysis

Spatial and attribute data were analyzed using ArcGIS 9.1. Locations of existing mariculture were plotted on digital basemaps to depict their distribution across the landscape of SE Sulawesi. Both attribute and water quality data are described thoroughly in corresponding sections of this report.

2.4. Survey Team

The survey team consisted of eight people, with each member qualified to perform the survey based on their expertise. Team members were from the

Research Centre for Indonesian Aquaculture (RCIA) and Faculty of Fisheries and Marine Science, Haluoleo University. A list of team members with their qualification is as follows:

1. Team Leader : Hatim Albasri, M.A (GIS/Aquaculture, RCIA)
2. Team Member : - Wa Iba, M.Sc. (Aquaculture, Hal. Univ)
   - Adang Saputra, M.Si. (Water Quality, RCIA)
   - Muh. Rajab, S.Pi. (Aquaculture, Hal. Univ.)
   - Ld. Abdul Umardin, S.Pi. (Technical Assistant)
   - Pono Sudrajat, S.Pi. (Technical Assistant)
   - Two boat drivers (Local people)

3. DISTRIBUTION OF EXISTING MARICULTURE ACTIVITIES IN SOUTH-EAST SULAWESI

As previously mentioned, the present study took place in three regencies (Muna, Buton and South Konawe) and two municipals (Kendari City and Bau-Bau City) of SE Sulawesi. However, it is important to simplify these administrative boundaries in clusters of locations so that a thorough analysis can be made especially on water quality analysis. It is also important to minimize redundant information because some study locations are too far apart or too close to each other. For the purposes of this report, 'Buton' refers collectively to Buton Regency and Bau-bau City, 'Muna' to Muna Regency and 'Kendari' to Kendari City and South Konawe Regency (see also Fig. 1 and Table 1).

There were eight villages taken as samples of this research representing the existing mariculture activities in Muna region, seven in Kendari region and 22 villages in Buton region. A list of villages and their spatial and attribute information is presented in Tables 3, 4 and 5. The location of key mariculture activities in the three designated study areas within SE Sulawesi are graphically depicted in Figures 2, 3 and 4 for Kendari, Muna and Buton respectively. The location of seed source for such activities in SE Sulawesi is depicted in Fig. 5. In general, almost all existing mariculture activities in SE Sulawesi practice similar techniques for the same species, and likewise face similar problems in business development.

Table 3. Spatial and attribute information of surveyed location in Kendari City, South-East Sulawesi (-, no data available)

Sub-district	Village	Coordinate		Pop^n No.	Est. No. Producers			Cultured Species
		Longitude	Latitude		Men	Women	Total	
Abeli	Petoaha	122.60298	-3.9845	1392	44	0	44	Seaweed, grouper, spiny lobster
	Bungku toko	122.61297	-3.99208	1502	102	2	104	Seaweed, grouper
	Tonddonggeu	122.64227	-4.00255	804	30	9	39	Seaweed
	Sambuli	122.63004	-4.00466	1108	102	4	106	Seaweed, grouper
	Lapulu	122.58447	-3.97935	-	-	-	-	Seaweed (middlemen only)
	Anggoeya	122.55092	-3.99311	-	-	-	-	Grouper (middlemen only)
Nth Kendari	Kandai	122.58057	-3.9716	-	-	-	-	Seaweed, abalone (& middlemen)
Soropia	Bokori	122.66379	-3.92541	649	50	2	52	Spiny lobster, abalone, seaweed
	Mekar Jaya	122.65776	-3.92624	-	-	-	-	Seaweed, grouper, abalone
	Mekar	122.65408	-3.92552	1027	-	-	-	Grouper, spiny lobster
	Bajo Indah	122.64668	-3.92434	713	-	-	-	Grouper, abalone, sea cucumber
	Leppe	122.64619	-3.92761	-	-	-	-	Grouper, abalone, sea cucumber
	Tapulaga	122.64325	-3934148	273	-	-	-	Grouper, abalone

Table 4. Spatial and attribute information of surveyed location in Muna Island, South-East Sulawesi (-, no data available)

Sub-district	Village	Coordinate		Pop^n No.	Est. No. Producers			Cultured Species
		Longitude	Latitude		Men	Women	Total	
Duruka	Bone Balanno	122.73680	-4.86492	429	108	18	126	Seaweed
	Lagasa	122.73671	-4.86506	-	-	-	-	Sea cucumber, spiny lobster
Napabalo	Renda	122.69920	-4.57583	257	30	-	30	Seaweed, spiny lobster, grouper
Guali	Tanjung Pinang	122.53497	-4.70208	402	41	6	47	Seaweed, sea cucumber, grouper
North Tiworo	Belo (Tiga Isl)	122.32657	-4.58503	449	32	4	36	Seaweed, abalone, grouper
	Santiri	122.35850	-4.73878	573	188	18	200	Seaweed, abalone, grouper
Maginti	Bangko	122.33804	-4.90839	288	38	11	49	Seaweed, abalone, grouper, sea cucumber
	Gala	122.27271	-4.86985	400	120	15	135	Seaweed, sea cucumber

Table 5. Spatial and attribute information of surveyed location in Buton, South-East Sulawesi (-, no data available)

Sub-district	Village	Coordinate		Pop^{n}	Est. No. Producers			Cultured Species
		Longitude	Latitude	No.	Men	Women	Total	
Betoambari	Sulaa	122.55939	-5.50756	1394	100	0	100	Seaweed
	Lamangga	122.59879	-5.41855	2548	250	0	250	Seaweed
Bungi	Palubusa	122.66396	-5.3214	1789	106	0	106	Seaweed, pearl oyster
Kapuntori	East Lambusango	122.8042	-5.22898	1600	104	100	204	Seaweed, pearl oyster
	Kamelanta	122.77029	-5.25336	-	100	0	100	Seaweed, pearl oyster
	Tobea	122.7014	-5.28833	-	100	0	100	Seaweed, pearl oyster
Kokaluna	P. Makassar	122.6228	-5.42637	4240	54	20	74	Seaweed, sea cucumber, abalone, grouper
Lakudo	Boneoge	122.52503	-5.39001	-	90	15	105	Seaweed, grouper
	Lolibu	122.49197	-5.29318	1000	208	0	208	Seaweed, sea cucumber, spiny lobster, grouper
	Waara	122.56848	-5.41149	-	-	-	-	Grouper, spiny lobster
	Wajogu	122.51193	-5.28925	-	150	0	150	Seaweed
Lea-lea	Lowu-lowu	122.62697	-5.41084	-	50	0	50	Seaweed
Mawasangka	Mawasangka	122.28896	-5.28413	-	50	0	50	Seaweed
	Watolo	122.28506	-5.28764	-	65	24	89	Seaweed, sea cucumber, sp. lobster, grouper, abalone
	Wakambangura	122.26675	-5.34534	1547	75	25	100	Seaweed, grouper
Miurhum	Bone bone	122.52503	-5.39001	5418	150	100	250	Seaweed
Pasar Wajo	Kombeli	122.84628	-5.53019	-	-	-	-	Grouper middlemen only
Sampolawa	Katilombu	122.69669	-5.63769		100	0	100	Seaweed
Siompu	Karae	122.5429	-5.62864		75	5	80	Seaweed
Siotapina	Matanauwe	123.0088	-5.4123	1300	44	0	44	Seaweed, sea cucumber
Sth Lasalimu	Lasalimu	123.15755	-5.24725	160	104	100	204	Seaweed, grouper
Wabula	Holimombo	122.89326	-5.56563	5248				Grouper
West Siompu	Lalole	122.47019	-5.68094	2028	200	50	250	Seaweed
	Watuampara	122.4724	-5.6784	21132	100	50	150	Seaweed
Wolio	Batara Guru	122.60752	-5.46367	-	-	-	-	Abalone, sea cucumber (& middlemen)
	Wale	122.60448	-5.45346	-	-	-	-	Seaweed, sea cucumber, abalone (& middlemen)

Fig. 2 Location of Existing Mariculture Activities in South-East Sulawesi – Kendari Region

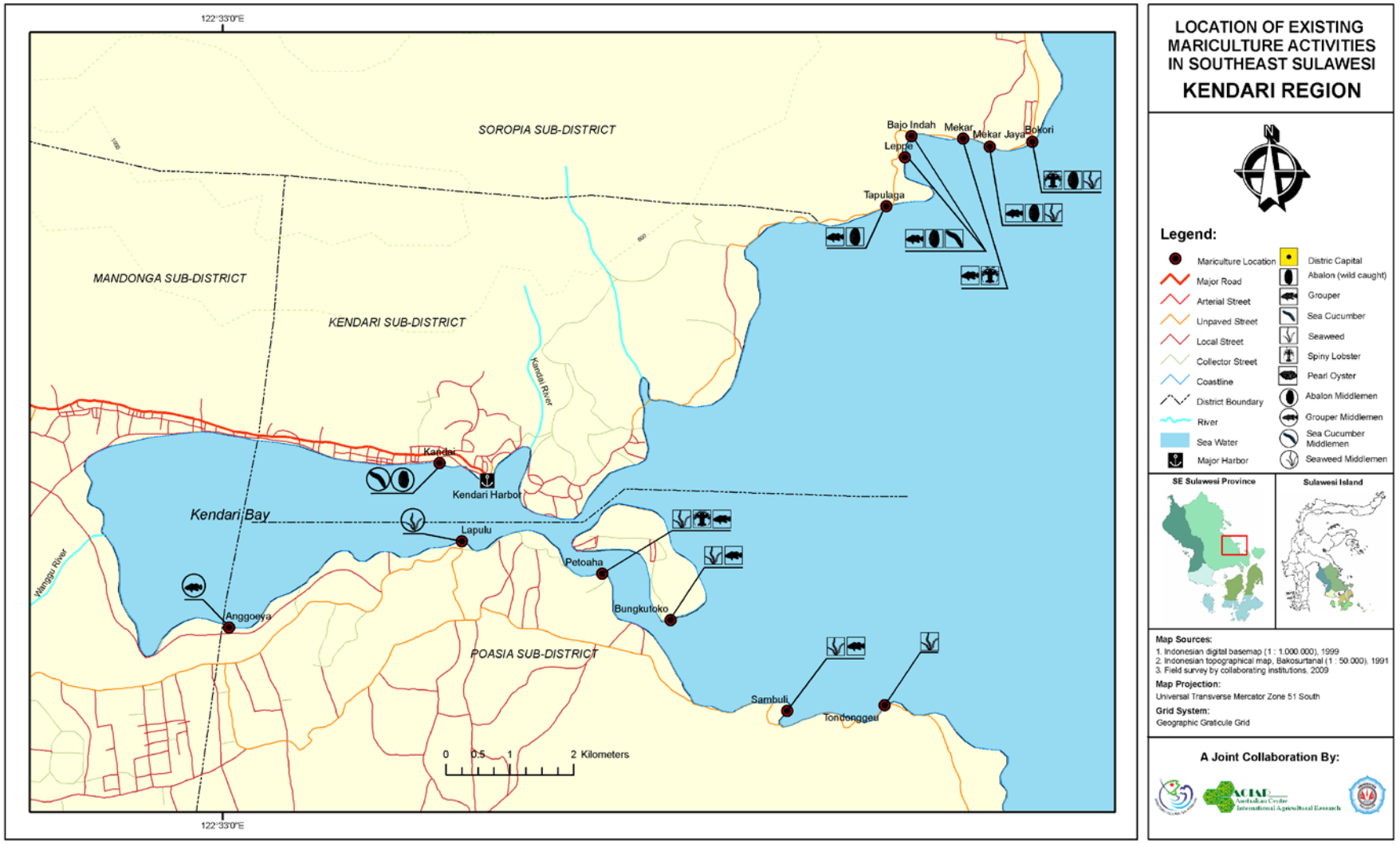


Fig. 3 Location of Existing Mariculture Activities in South-East Sulawesi – Muna Regency

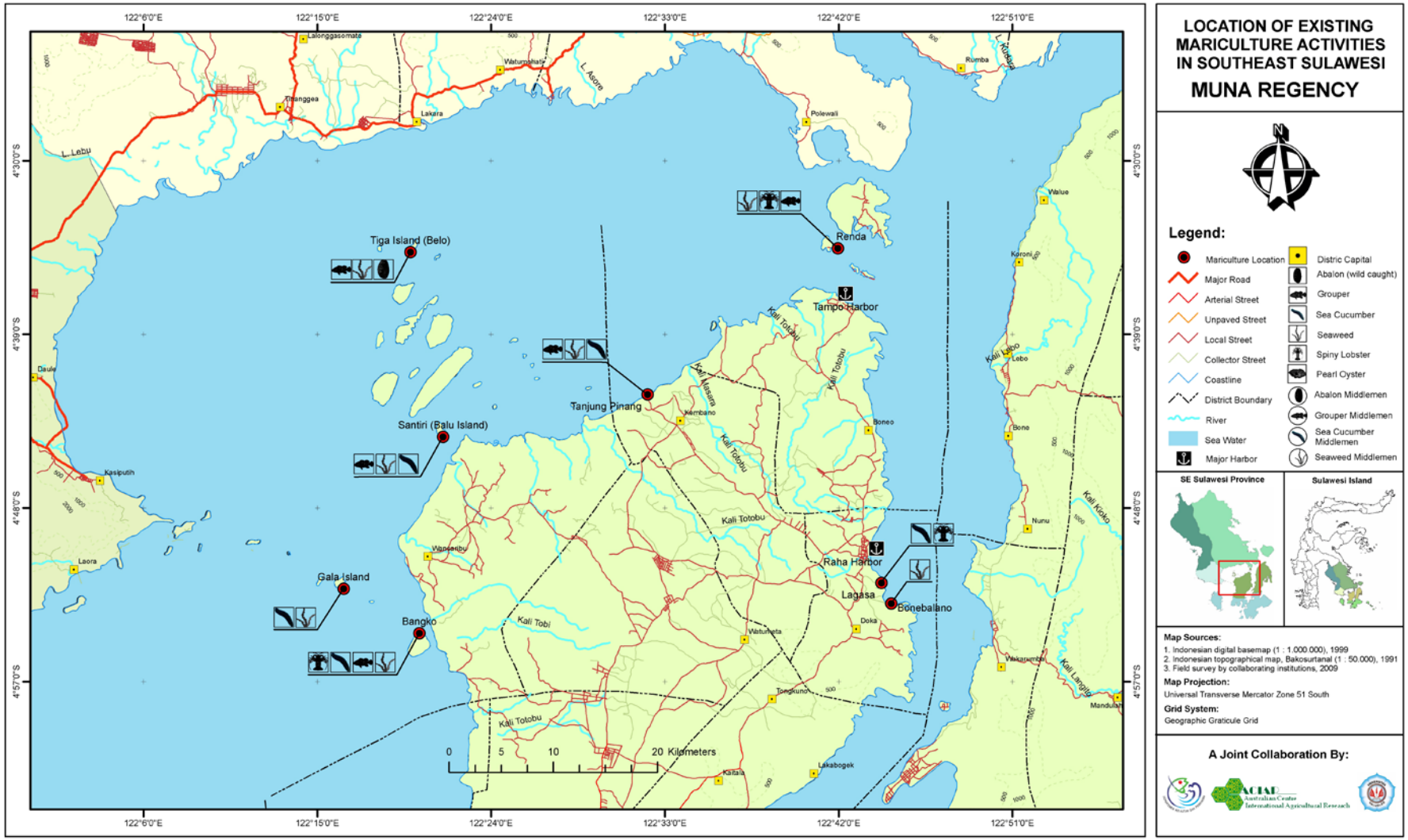


Fig. 4 Location of Existing Mariculture Activities in South-East Sulawesi – Buton Region

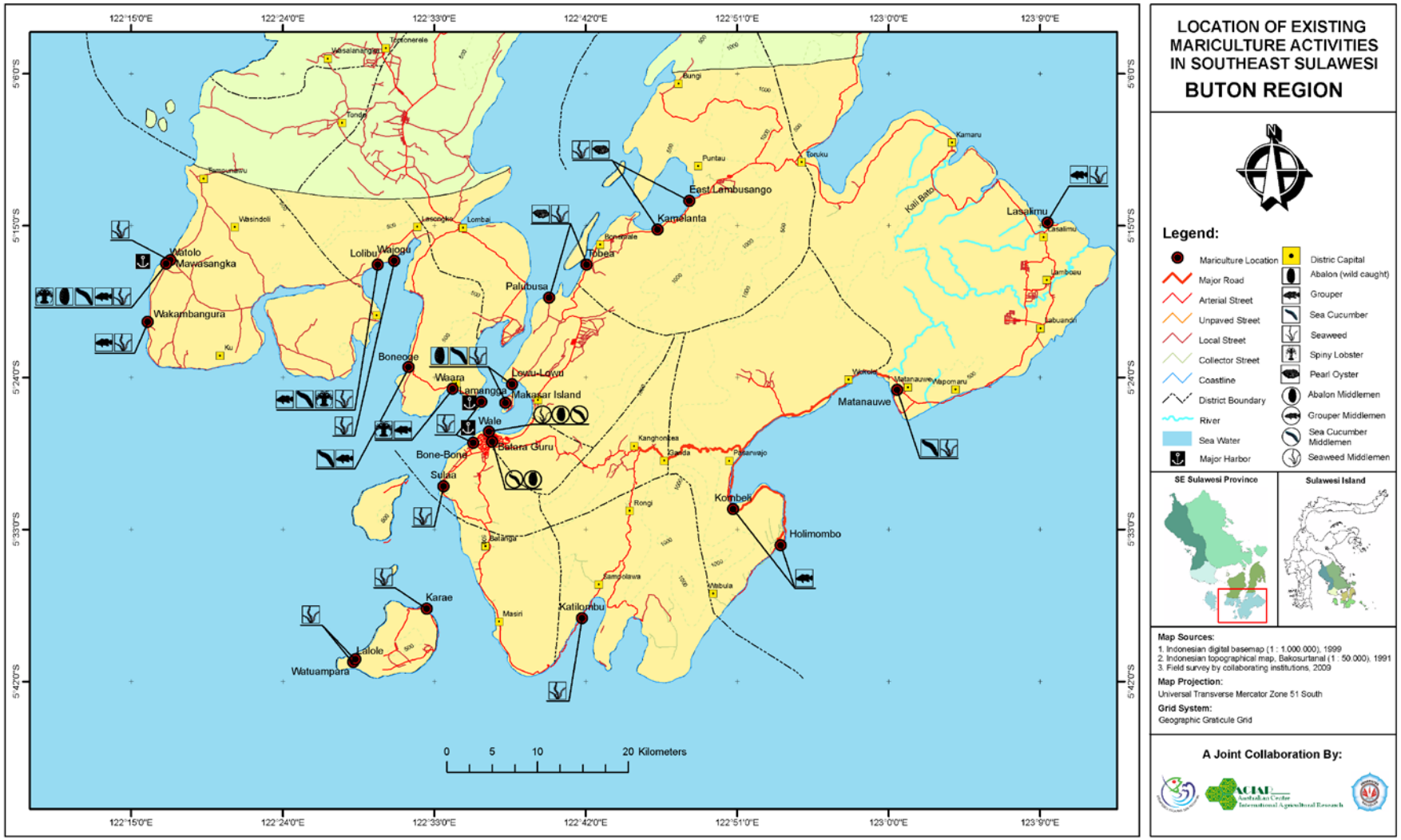
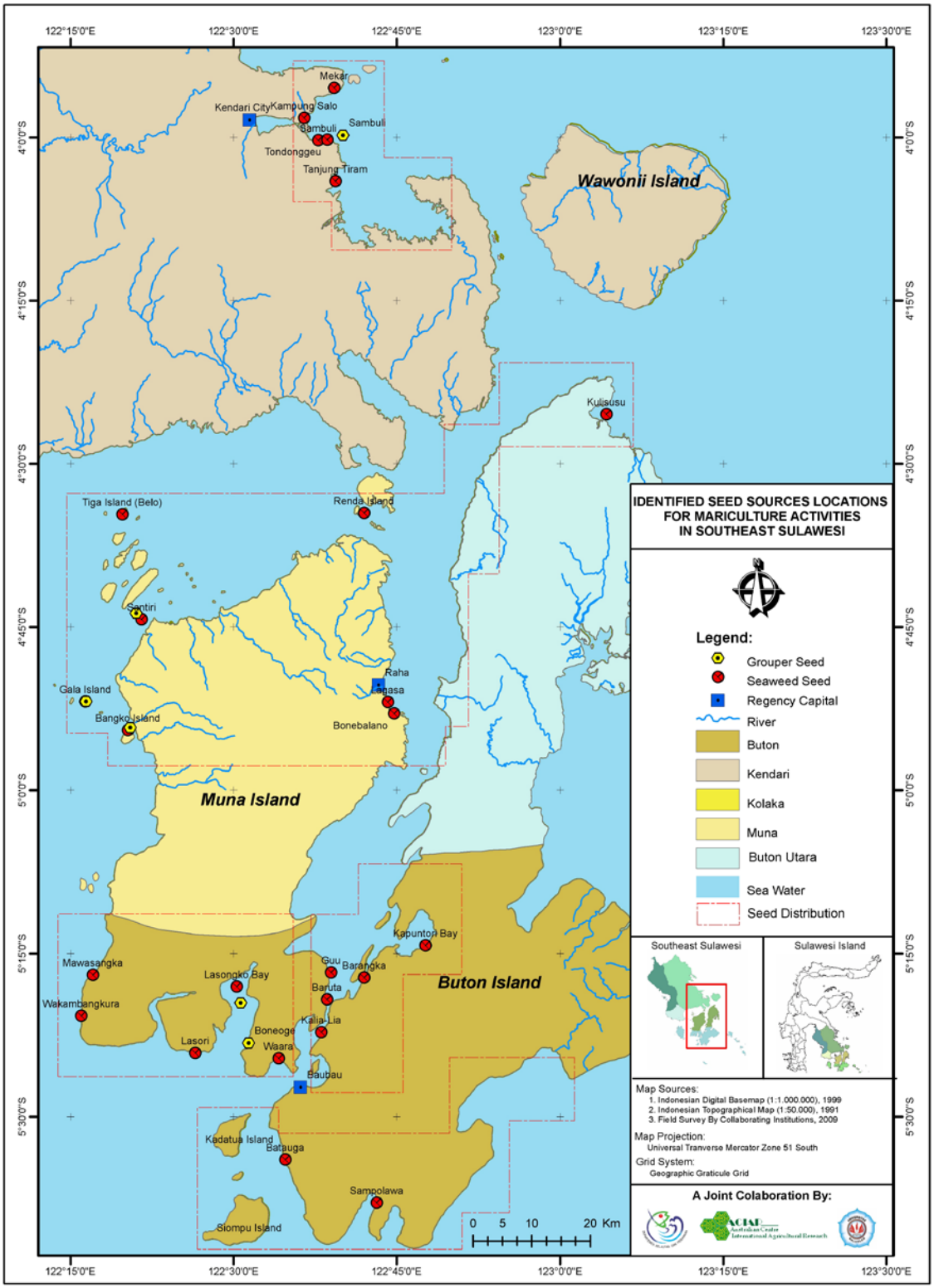


Fig. 5. Location of Identified Mariculture Seed Sources in SE Sulawesi



3.1. Seaweed

It is evident from the present study that seaweed has taken the priority as the main source of livelihood for villages throughout SE Sulawesi. Seaweed in particular has gained significant attention from producers all around SE Sulawesi due to increasing market demand and price as well as its uncomplicated culture process. Other 'higher value' mariculture activities such as grouper, spiny lobster, abalone and pearl oyster are mostly maintained by producers with access to more substantial financial capital. In some areas of SE Sulawesi, as reported by Albasri (2008), many producers who culture grouper and other highly valued mariculture species have switched to seaweed culture because of the lower risks and capital requirements.

Eucheuma (Kappophycus) cottonii is the only seaweed species cultured in SE Sulawesi at the moment, although wild stock of other species such as *Gracillaria verrucosa* can be found around Muna Island and Buton. Rope or "tali" on which seaweed is cultured is the common term for the production unit used as a measure of the scale of any one seaweed farm. On average, each producer in SE Sulawesi has 30 – 45 ropes. If one rope has an average length of 100m, then each farmer typically has more than 3 km of 100 m ropes placed parallel to each other and stretched from the beach to the sea. This practice has been the source of several problems and conflicts with other coastal users.

The most common practice to cultivate seaweed in Muna Island and Kendari is using long-line with seed plants tied along the ropes with 15-20 cm gap (Fig. 5 and 6). In Buton however, long-line and raft systems have both been used. Seed is collected from farmers who specialize in culturing seeds of seaweed or from farmers with seaweed that has been cultured for not more than 20 days. Price of seed varies from Rp. 1500 to 2000 per kg, depending on the seed quality and the distances that have to be travelled to get the seed. The seaweed is then cultured for 20-30 days for seed production or 40-45 days for production of fully grown, dried seaweed. Seaweed is favoured by farmers due to the limited effort required. Farmers only have to monitor

integrity of the rope and clean the seaweed of algae and trapped debris. Other than that, seaweed farmers rely on natural production from sunlight, nutrients and water quality.

Besides problems from epiphytic algae and natural predators such as the herbivorous rabbit fish, *Siganus siganus*, “ice-ice” disease is the most common problem faced by seaweed farmers. This disease is so called because of the white tips which form on the plants, thought to be in response to excessive freshwater run-off from the catchment. A Massive “ice-ice” outbreak may leave farmers with only the trunk of the seaweed, which represents 5-10% of the expected harvest. Some seaweed farmers deal with this problem by not cultivating seaweed if news of “ice-ice” outbreak is heard, or not cultivating in the periods when “ice-ice” is known to most likely occur.

It is estimated that each farmer can produce from 300 to 1000 kg of dry seaweed per culture period. According to local middlemen (”tengkulak”), most dried seaweed purchased from farmers has water content of 35-40%. The “tengkulak” has to reprocess the seaweed further so that the water content can be lowered to between 30-35%. It is difficult to expect seaweed farmers to supply dry seaweed with expected water content because they rely on sunlight to dry the seaweed, and they cannot afford to buy tools to measure water content. They also don’t have adequate permanent storage room to store dried seaweed before they can sell it to the middlemen, as quality (and price) decreases with time if drying and storage is not carried out correctly.

Most farmers market their ‘dry’ seaweed locally (within villages) to the “tengkulak”, who are part of the village (or neighboring) community. The “tengkulak” often provide financial support to farmers during culture periods, hoping that they will sell their seaweed to them at harvest. This type of relationship sometime is so strong that outside “players” (non-local middlemen) cannot compete with the local middlemen, despite offering better prices. A small number of successful farmers can afford to sell seaweed directly to exporters in Makassar and Surabaya by using their own boats and/or cars for transport to the point of export, or by asking the exporters to pick up the supply at their place of production but at a reduced price.

Seaweed farmers and middlemen in Muna sell their dry seaweed directly to Bau-bau or Kendari by transiting through Tinanggea or Tampo. Farmers in Buton channel their production to Bau-bau. Farmers in Muna are confronted by poor roads and minimum transportation support, which forces them to direct their production in the first instance to markets in neighboring regencies such as Buton, Tinanggea and Kendari. Most seaweed is then exported from Bau-bau and Kendari via Makassar and Surabaya. Kendari has its own major harbor, which allows exporters to have bases to transport the seaweed in containers to Makassar or Surabaya.

Price of seaweed at the time of the survey in the present study varied between Rp. 5800 – 8500. Within the past three years, price has been quite volatile, ranging between as Rp. 3500 - 20.000, subject to market demand. This unstable market price has made some middlemen go bankrupt when they buy seaweed from producers at a higher price before realizing that the export price has decreased significantly. One of the greatest risks for local middlemen is that they do not know the real-time price of seaweed on the export market, as this information is limited by the exporters. According to one local middleman in Bone-bone village, Bau-bau, the selling margin on seaweed typically ranges between Rp. 500 – 1000 per kg. Furthermore, this does not include the risk that the seaweed may contain more water than expected (i.e. has not been adequately dried), which may reduce the margin to between only Rp. 250 – 500 per kg.

Another problem with the development of this sector in SE Sulawesi is that seaweed is sold as raw product with no processing or other value-adding. There has been little effort in Indonesia in general to develop integrated seaweed industry that combines mass production with supporting post-harvest industries. Final price of seaweed can be increased significantly by processing to extract thickeners/carageenans used as raw materials for cosmetics, food and medicinal products. By developing such integrated industries in SE Sulawesi, seaweed production would be boosted, supply chains streamlined and margins and overall livelihood and well being increased for all stakeholders.

Figure 6. Long-line method of culturing Seaweed

Figure 7. Harvesting Seaweed

3.2. Grouper

Grouper mariculture in SE Sulawesi was in part developed to answer the increasing international market demand, and was supported through an important local government program developed by the Department of Marine Affairs and Fisheries. Grouper culture in the Province mostly involves fattening of juveniles in fixed net cages (also referred to as pens) (Fig. 7). Up until now, this practice is still favored by farmers compared to the relatively more expensive and difficult to manage floating net cage method (Fig. 8).

From 47 villages surveyed in this study, five villages in Muna, eight villages in Kendari and seven villages in Buton were identified to have existing grouper mariculture. The most sophisticated methods of culturing grouper occur in the Kendari area where floating net cages are well constructed and equipped with electricity, backup generator and in some cases living quarters for staff (even including air-conditioning in one facility off Bokori village). Fixed net cages are also still widely used to culture grouper in Kendari by traditional fish farmers. In Muna and Buton, most farmers use fixed net cages attached to the back of their houses for reasons of security and practicality in monitoring the fish. Additionally, some farmers in Buton are using ponds to culture grouper, especially for tiger grouper. The high risk involved, lack of financial resources, technical expertise and institutional support are the main constraints preventing farmers moving to better management practices for grouper culture in SE Sulawesi.

Of the 15 genera and 159 species of groupers available in Indonesia, the most favored genera to be cultured in SE Sulawesi and Indonesia in general are *Ephinephelus* and *Mycteropera* (Pierre *et al.* 2007). *E. tauvina*, *Cromileptes altivelis* and *E. coioides* are the most common species used in fixed and floating net cage culture in Muna, Kendari and Buton. More specifically, floating net cages in Kendari are stocked only with *C. altivelis*. This species requires special handling compared to other commonly cultured species, and typically only the bigger farms can afford the relatively higher costs.

There are two main sources of grouper seedstock in SE Sulawesi. In Muna and Buton, wild-caught seed is collected from surrounding coastal waters by the fish farmers themselves or by local fishermen who then on-sell to the farmers. In Kendari, wild-caught seed is collected and purchased from local fishermen, and hatchery-bred seed is purchased from Bali. One particular fish farmer in Lolibu village, Buton, has tried hatchery-bred seed from Bali but with disappointing results, as most fish died before they reached marketable size. Poor seed quality, unsuitable environment and incorrect handling techniques were blamed by the farmer, who subsequently relies only on wild-caught seed. Wild-caught seed used by fish farmers in all surveyed locations varies in size between 3 – 6 cm, and in price between Rp. 1000 – 6000 per piece (depending on the seed size). The price for hatchery-bred seed from Bali to fish farmers in Kendari is presently Rp. 7000/piece.

Fig. 8. Fixed Net Cage (pen) for Grouper in Kendari

Fig. 9. Floating Net Cage for Grouper in Kendari

Most grouper farmers using fixed net cage systems in surveyed locations practice traditional rearing and feeding techniques. In Muna and Buton, grouper are fed once or twice daily, depending on the availability and supply of fresh trash fish supplied by local fishermen. There is no special estimation on how much feed should be given to cultured fish, and they are not fed sometimes for a couple of days because fresh trash fish are not available. In Kendari, farmers have begun to use pelleted feed to reduce the dependence on trash fish. Improved feeding techniques with measured feeding rates of 5 – 10 % of total body weight/day apply for semi-intensive and intensive floating net cage systems.

In terms of production, fish are harvested after being reared for a period of 16 – 18 months. Fish are sold live to buyers who come regularly to the village. In Kendari, fish are sold locally to middlemen at Kandai. The middlemen then on-sell to other (upper level) middlemen and/or exporters in Surabaya or Makassar. At least one farmer in Kendari also sells directly to buyers in Hong Kong, with regular live haulage shipments directly from the

cages. For farmers in Buton and Muna, live grouper are also sold to buyers from Surabaya, Makassar and Hong Kong who come with their live-haulage ships to the villages. The price for market size live fish varies between Rp. 50,000 – 70,000/kg for Tiger grouper (*E. fuscoguttatus*), Rp. 300.000/kg for super size tiger grouper, Rp. 40.000 – 60.000/kg for estuary grouper (*E. tauvina)* and Rp. 100.000 – 200.000/kg for mouse grouper (*C. altivelis*). Because most of the traditional farmers only have 2 – 4 frames (production units) within each cage system, each production cycle only yields between 100 – 200 kg of saleable product.

Little is known about the post harvesting processes for grouper culture due to the fish being transported live outside the country to be sold, processed and served in restaurants in Hong Kong, China, Singapore and Taiwan.

3.3. Sea Cucumber

Sea cucumber culture in SE Sulawesi is presently facing many challenges. Out of 47 surveyed villages, only one village in Kendari and five villages in Buton and Muna combined were identified as supporting sea cucumber culture activity, of which only Lolibu Village, Buton Regency, was still culturing sea cucumber at the time of the field survey. Other locations were identified as having sea cucumber culture activity based on information from interviewees and previous surveys as part of the ACIAR project. Some villages are thought to have stopped culturing sea cucumber of recent times due to technical difficulties and also the increasing popularity of seaweed culture in the Province, although wild-caught sea cucumber is still produced and marketed in these villages.

In Lolibu Village, only one farmer cultures sea cucumber, the sandfish (*Holothuria scabra)*. Wild-caught seed is collected from nearby shores by the fish farmer himself, or by local fishers who sell the seed for Rp. 350/piece at a size of 3 – 5 cm. The seeds are placed in traditional stone ponds sized 125 x 50 m at a stocking density of about 2000 seed/pond. They are fed once a week with crumbled sea urchin and left over/trash fish. They reach market size after about seven months, with a harvest of 100- 200 kg of fresh sea

cucumber. Once harvested, they are cleaned and dried and sold at market size for about Rp. 5000/piece to a buyer from Jakarta.

Fig. 10 Semi-Traditional Sea Cucumber Pond in Buton

The major problem faced by the farmer in Lolibu village, as for other sea cucumber farmers in the Province, is that it is difficult to contain sea cucumber in traditional ponds (Fig. 9). The farmer has expressed his concern by stating that "…..culturing sea cucumber is like rearing genies. One day you stock 2000 seeds, and the next day every one of them is gone, no matter how well you secure your pond".

The increasing market demand for sea cucumber and the scarcity of wild-caught product indicates good potential for developing sea cucumber culture in SE Sulawesi. Introduction of new rearing techniques to potential sea cucumber farmers to avoid stock loss during the production period is required. Concrete ponds or net cages designed specifically for rearing sea cucumber need to be developed and extended to local farmers. Financial assistance and technical support are required to facilitate long term viability and sustainability of this sector.

3.4. Abalone

Abalone mariculture in SE Sulawesi has recently been initiated by several agencies and institutions with collective responsibility for developing mariculture and associated production systems in this Province. The commercialization of abalone culture in the Province is still fully dependent on supply of wild caught stock. Among 47 surveyed villages, three villages in Muna (Belo, Santiri, Bangko), five villages in Kendari (Bokori, Mekar Jaya, Bajo Indah, Leppe and Tapulaga) and only two in Buton (Watolo and Pulau Makassar) have marketed abalone from culture-based activities.

The development and adoption of abalone culture by traditional fishers in SE Sulawesi faces several major problems, including decreasing stock of wild-caught seed, a lack of hatchery-bred seed for regular supply to farmers, low level of expertise in abalone farming techniques, and a lack of support from local government in the form of training, capacity building and market information. Initial reproduction and grow-out research has recently been developed by researchers from Haluoleo University and the Provincial Office for Marine Affairs and Fisheries. The latest development of the research is that wild-caught, captive reared abalone (*Haliotis asinine*) can be stimulated to reproduce under semi controlled environment conditions. The resultant seeds are being used for purposes of restocking otherwise depleted abalone wild stocks in known natural habitats (also referred to as sea ranching, stock enhanced capture fisheries and culture-based fisheries).

Abalone is a relatively high-value product with reliable market demand. In Kendari, buyers from Kandai are readily available to collect wild-caught abalone directly from fishers. Likewise, in Buton middlemen from Wale and Batara Guru villages regularly visit local villages to collect wild-caught abalone. The village price of abalone varies between Rp 300.000 – 400.000/kg, depending on the water content (after processing and drying) and size of the abalone. For these reasons, the abalone supply chain is not as long as for other cultured species in SE Sulawesi. Most of the buyers are businessmen with direct access to overseas export markets where the wholesale price of dry abalone can reach Rp. 700.000/kg. To optimize

margins and overall profitability, it is important for abalone fishers and farmers to meet or communicate directly with the exporter to ensure they receive reliable and timely information regarding the latest export market price for abalone. The involvement of local government in assisting abalone producers for this purpose is important to ensure that they can get a fair deal.

3.5. Spiny Lobster

Spiny lobster (*Panulirus* spp.) culture in SE Sulawesi is also similar to that of abalone culture. Most of the seed are collected from the surrounding coastal areas and reared to a certain market size. In most cases, wild caught seeds of spiny lobster are in fact adults, which are reared in traditional fixed net cages (Fig. 10) and maintained until sold or fattened to market size. When the lobsters reach marketable size, the buyers collect directly from the farmers.

The location of existing spiny lobster culture in Muna is found in Lagasa and Renda Island, in Lolibu, Waara and Watolo villages in Buton, and in Petoaha, Bokori and Mekar villages in Kendari.

Fig. 11 Spiny Lobster Fixed Net Cage in Kendari

Market size spiny lobster can be locally traded for Rp. 250.000 – 300.000/kg. This price has been steadily increasing due to high export market demand and the scarcity of wild-caught stocks. Traditional fattening culture techniques have been practiced by fishers in SE Sulawesi for decades, but with no further development or improvement in rearing techniques. Due to the increasing export demand and associated market price, the sustainability of spiny lobster production in SE Sulawesi is in jeopardy as signs of overexploitation of wild stocks are now apparent. The smaller size of harvested stocks and increased distances to fishing grounds of spiny lobster are examples of a fishery under pressure, and further reasons why more sustainable spiny lobster mariculture practice should be developed as a priority in SE Sulawesi.

3.6. Pearl Oysters

Buton is the only region where pearl oyster (*Pteria penguin*) mariculture is undertaken in SE Sulawesi. Four villages are currently culturing pearl oysters i.e. Palubusa, East Lambusango, Kamelanta and Tobea, although production is presently in decline. Decreasing water quality at the production sites, and expansion of seaweed farming have collectively undermined prospects for pearl oyster farming in SE Sulawesi.

Mabe pearls are produced in this location, known locally as “Kerang Mabe”. Due to the relatively high capital requirement for floating net cage production of pearl oyster stock, the commercial enterprise is managed by a group of people or business entities specializing in production of pearl oysters and mabe pearls.

The average size of each floating net cage is around 16 x10 m, consisting of 15 boxes in which cultured pearl oysters are placed, each of which is stocked with 7.000 - 10.000 individual, wild-caught seed oysters purchased from fishermen at Kapuntori bay. The boxes are placed in steel frames and lowered to a depth of 15 - 25 m. The initial price of pearl oyster seed varies between Rp. 400 – 600/piece (sized of 2 - 3 cm). The culturing period for pearl oyster is up to six months before it can be harvested and sold to the local private pearl oyster farm for purpose of pearl production.

With the recent expansion of seaweed farming in Buton regency, a major problem faced by pearl oyster farmers is gaining ready and safe access to net cage platforms. The platforms are increasingly surrounded by seaweed farming infrastructure, which is causing difficulty in undertaking routine maintenance and management. Recent developments in seaweed farming where liquid fertilizer is being used by farmers in the area to boost production is posing another risk for the industry. Decreasing water quality from pollution caused by boats and other small vessels passing the area has been also been claimed by one pearl oyster farmer in Palabusa village. There are no local government planning provisions in place to ensure that pearl oyster mariculture can maintain its existence side by side with seaweed farming. A designated management area based on site suitability analysis and spatial layout for mariculture activities is required in order to prevent impacts, such as the case in Makassar Island where pearl oyster farms in that area moved to East Nusa Tenggara due to impacts of water pollution and otherwise unmanaged mariculture activities.

Fig. 12 Mabe Pearl Oyster (*Pteria penguin*) culture at Palabusa Village

Fig. 13 Structure of Mabe Pearl Oyster (*Pteria penguin*) platform

3.7. Summary

In SE Sulawesi, there are three big spatial clusters of existing mariculture activities in Kendari, Muna and Buton regions. The Kendari cluster is based on coastal villages located along the coastline of Kendari Bay. In Muna, the cluster is located around Tiworo archipelago, and in Buton is centered along the coastline of Buton Strait. These clusters are in fact key 'centres' of both production and marketing of mariculture produce for fishers, farmers and local/low level middlemen.

Most producers in SE Sulawesi are still practicing traditional mariculture techniques, using wild-caught seed of local species sourced and reared close to their homes. Locally available materials are used for constructing production facilities, including cages, pens and platforms, with low input and density rearing techniques producing relatively low output. The lack of financial support, knowledge and skills, market information and institutional assistance have made it difficult for these producers to enhance profitability and overall welfare of livelihoods through mariculture activities.

Mariculture site capability and suitability analysis of existing mariculture activities and potential area for development in SE Sulawesi has not been utilised by stakeholders involved in coastal zone management. The lack of properly planned, integrated management areas for multiple overlapping economic activities in the Province has resulted in crowded and poorly managed coastal development. Sensitive mariculture activities, such as pearl oyster production, have been forced from the area due to a lack of adequate planning and management, particularly as a result of environmental impacts form other activities.

Finally, the supply chain for many mariculture products in SE Sulawesi is relatively long, especially for seaweed, grouper and spiny lobster. Production locations with no land transportation (small islands), or which are geographically isolated from market centres, are at a particular disadvantage. as farmers incur greater costs to get their products sold. Shorter, more integrated supply chains would reduce costs, and increase quantity and quality of products and overall profitability of farmers. Developing integrated local industries which add value to raw materials through processing and production of ‘ready to eat’ products would be advantageous to the livelihood of local fish farmers in particular and for the economy of SE Sulawesi in general.

4. KEY WATER QUALITY PARAMETERS AT MARICULTURE LOCATIONS IN SE SULAWESI

The Indonesian coastline totals over 80,000 km, and is characterized by numerous bays and inlets and associated estuaries, sandy beaches, protected and navigable straits and thousands of small islands. Such geography is ideal for sustainable coastal zone development and management of mariculture.

SE Sulawesi has approximately 8.4 million ha of indicative area for potential mariculture development (Table 6), including up to 775,000 ha suitable for culture of abalone, lobster and finfish in floating net cages, up to 37,000 ha suitable for culture of finfish in fixed fish net cages, 770,000 ha for seaweed farming, 4.7 million ha for shellfish aquaculture, 175,000 ha for sea cucumber and 1.9 million ha for pearl oysters, of which about 3.8 million ha in total is the effective area for potential development (Dirjen Budidaya 2005).

Table 6. Potential area for mariculture development in SE Sulawesi

Commodity	Potential (Ha)	
	Indicative	Effective
Finfish, abalone, lobster	812,000	8,000
Seaweed	770,000	385,000
Shellfish	4,700,000	2,350,000
Sea cucumber	175,000	88,000
Pearl Oyster	1,900,000	945,000
Total	8,357,000	3,776,000

Source: Dirjen Budidaya (2005)

The general bathymetry of the coastal zone of SE Sulawesi, incorporating the major mariculture production centres for the species of interest to this study, is provided in Fig. 14. This highlights the extensive area of relatively shallow, protected coastal waters in which existing mariculture activities take place in the Province.

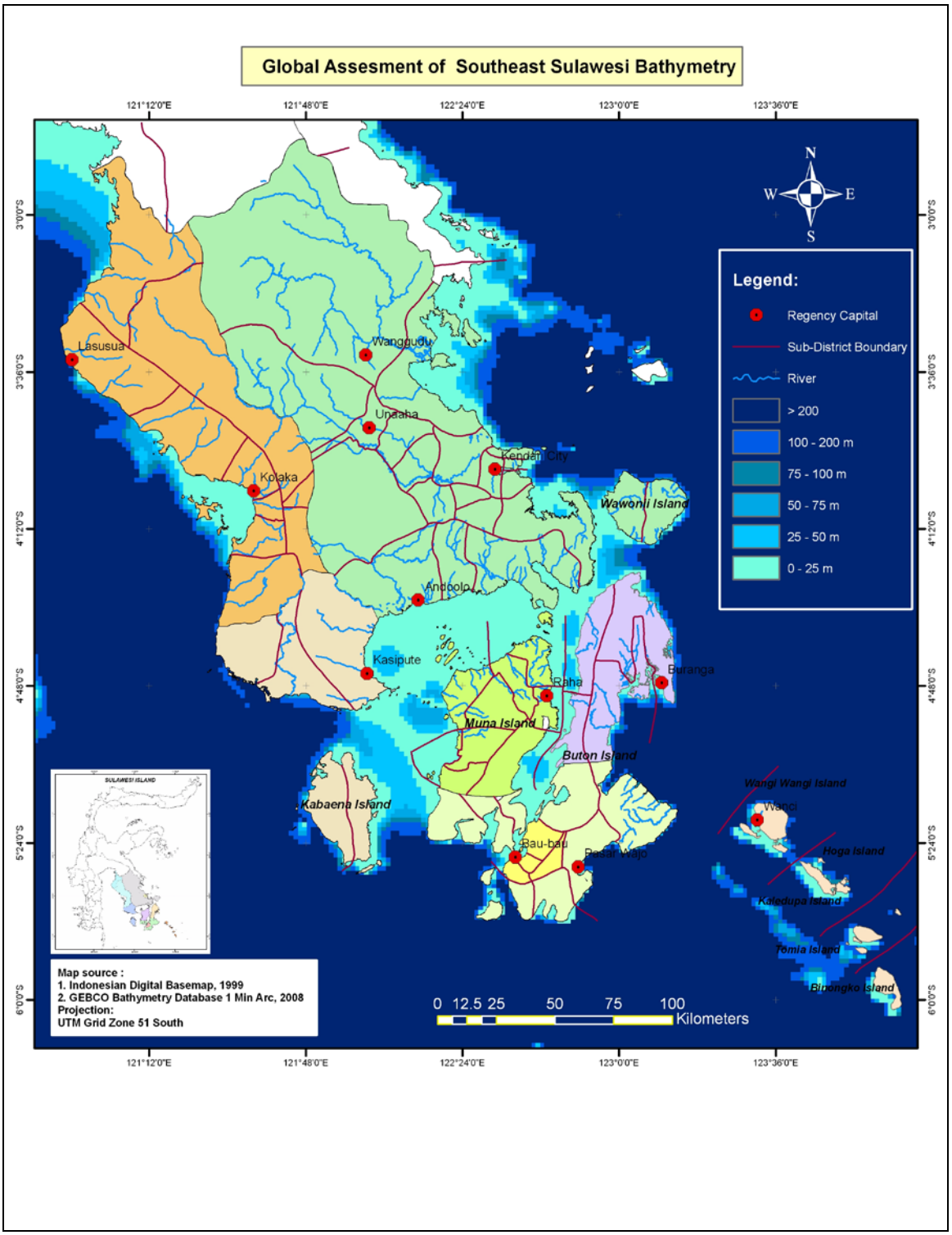


Fig. 14. General bathymetry of key mariculture areas within the coastal zone of SE Sulawesi.

Considering the scale of this potential and the current status of Indonesian aquaculture, a precautionary approach to development is necessary to ensure the sustainability of aquaculture activities and associated impacts on natural resources. Indeed, mariculture activities should comply with national strategy in developing coastal and marine areas throughout Indonesia (Stead *et al.*, 2002; GESAMP, 2001). Specifically, monitoring and assessment of key water quality parameters are critical factors determining the success and sustainability of any mariculture activities (Purnomo 1992).

In the present study, key water quality parameters in the major mariculture areas of SE Sulawesi have been characterized and summarized for reconciling against existing and proposed mariculture activities.

4.1. Muna Island

In general, waters around Muna Island are considered not to have been impacted by development and to be within the range of standard water quality values considered suitable for mariculture (Table 7). Waters around Muna Island have a total Storet score of -5 (Table 8) which indicates that water quality is classified as 'good' and that this area is moderately to highly suitable for mariculture activity. From six measured parameters, only pH and water clarity are rated as 'fair', but both parameters are typically variable and subject to ambient weather and oceanic conditions. Under these conditions, one-off measurements are of limited value in assigning overall ratings.

Temperature

According to Gunarso (1985), most fishes are sensitive to temperature variation. Optimal temperature for fish culture in tropical climates is generally ranging between 27–32 ^{O}C (Mayunar *et al*.,1995). Water temperature in the location of existing mariculture activities around Muna Island varies between 28.5–30.6 ^{O}C. This value is categorized as suitable for mariculture according to the standard by the KLH (2008).

Water Clarity

Water clarity is a function of suspended and colloid matter in the water, typically in the form of plankton biomass (Wardoyo, 1998) and/or sediment, and collectively measured in the form of secchi disk depth, turbidity and total dissolved solids (TDS). In the present study, water clarity of waters around Muna Island is still in good condition, with secchi disk depth ranging between 1.25 – 11 m. Based on the Storet analysis, water clarity scored -1 which means that sunlight penetration in the water is ranging from 'poor to optimal'. By looking at the total score of Storet index, the waters off Muna Island are classified into B class, which is an overall rating of 'good'.

Water Depth

Water depth is an important parameter in determining the suitability of production sites for mariculture. According to Beveridge (1996), the minimal water depth between the base of an aquaculture net-pen and the seabed is 4 – 5 m. Other species using different mariculture techniques require different water depths according to the specific need of each cultured species. Based on observation in the present study, most fish farmers in the Muna area place their net pens in water with a depth clearance of 1.25 – 41.5 m. For seaweed farmers, the depth for cultivation ranges between 0 – 30 m.

pH

The pH value determines the degree of acidity or alkalinity of the water, which is affected by CO_2 levels and acid substances. In fish culture, an extreme pH level can cause physiological problems with fish health, such as hemorrhaging on the surface of fish gills that can lead to mass mortality. Extreme pH values can also increase the toxicity effect of several pollutants such as ammonia and some heavy metals (Beveridge, 1996). Boyd & Licthkoppler (1982) suggest that the optimum range of pH in fish culture is between 6.5 – 9, with pH levels lower than 4 and above 11 being toxic to fish. Waters around Muna Island during the present study had a pH value between 6.4 – 8.3. Based on Storet analysis score of -2, this area is rated as suitable for mariculture activities.

Table 7. Water quality values around Muna Island (June-July 2010)

No	Depth (m)	Temp (^{0}C)	pH	DO (mg/L)	Salinity (mg/L)	Clarity (m) (secchi)	TDS	Location (mg/L)
1	11.9	29.0	8.3	6.6	33.2	2.00	32.81	Gala Isl.
2	4.3	29.1	6.9	6.0	32.1	2.00	32.48	Gala Isl.
3	10.0	29.3	7.1	5.6	33.2	2.00	33.05	Gala Isl.
4	4.3	28.9	7.0	6.9	33.1	3.50	33.13	Gala Isl.
5	9.6	29.8	6.6	7.7	33.2	3.50	33.03	Gala Isl.
6	18.5	29.2	7.4	4.9	33.3	8.50	33.09	Tiga Isl.
7	19.4	30.2	6.5	6.5	33.3	10.00	33.14	Tiga Isl.
8	23.0	29.9	7.4	7.3	33.2	11.00	33.08	Tiga Isl.
9	21.0	29.2	7.2	5.3	33.2	10.00	33.06	Tiga Isl.
10	10.7	29.5	7.3	6.2	33.3	10.00	33.13	Tiga Isl.
11	23.3	30.6	7.2	5.3	33.1	7.50	32.91	Tiga Isl.
12	24.0	29.6	7.3	5.5	33.3	10.00	33.1	Tiga Isl.
13	4.0	29.9	7.2	7.9	32.9	2.00	32.76	D. Bangko
14	1.2	29.8	6.4	6.8	32.3	1.20	32.39	D. Bangko
15	1.2	30.6	6.6	6.9	32.6	1.20	32.65	D. Bangko
16	2.5	29.9	6.6	5.7	32.2	2.00	32.27	D. Bangko
17	2.6	30.4	6.8	7.0	32.7	1.50	32.47	D. Bangko
18	4.0	29.9	6.7	5.5	33.0	2.50	32.81	Santiri Isl.
19	3.4	29.4	6.9	5.3	33.0	2.00	32.87	Santiri Isl.
20	2.2	29.5	6.4	5.3	33.1	2.00	32.97	Santiri Isl.
21	2.8	29.9	6.4	5.7	33.1	1.25	32.97	Santiri Isl.
22	5.9	30.4	7.2	5.2	33.3	2.5	33.74	T. Pinang
23	4.0	30.4	7.3	6.1	33.3	1.25	33.12	T. Pinang
24	4.6	30.2	7.3	5.4	33.3	2.00	33.13	T. Pinang
25	13.6	29.3	6.8	4.2	33.5	4.50	33.24	Rendra Isl.
26	3.0	29.1	7.1	4.6	33.4	3.00	33.22	Rendra Isl.
27	9.1	29.2	6.9	4.6	33.5	6.00	33.24	Rendra Isl.
28	2.6	29.4	7.1	4.6	33.5	2.60	33.28	Rendra Isl.
29	3.2	28.6	7.1	4.2	33.3	3.20	33.09	Rendra Isl.
30	1.3	28.5	7.0	4.2	33.4	1.30	33.21	Rendra Isl.
31	41.5	28.5	7.2	6.9	33.3	7.00	33.1	Rendra Isl.
32	2.1	28.5	7.1	4.2	33.4	2.10	33.14	Rendra Isl.
33	1.3	28.8	7.1	4.7	33.5	1.30	33.29	Rendra Isl.

Table 8. Storet score for measured water quality values for Muna Island

No	Parameter	Unit	Range	Analysis Result			Score
				Max	Min	Ave.	
1	Temperature	^{0}C	27-32	30,64	28,47	29,55	0
2	TDS	mg/L	1000	33,74	32,27	33,00	0
3	Clarity (secchi)	m	>5	11	1,25	5,08	-1
4	pH	-	7-8,5	8,28	6,36	7,04	-2
5	DO	mg/L	>5	7,86	4,16	5,75	-2
6	Salinity	mg/L	30-35	33,56	32,1	33,13	0
Total Score							-5

Note : Storet method (Centre, 1977); Kepmen KLH N0. 115 (2003)

Dissolved Oxygen

Dissolved oxygen (DO) is considered one of the most important factors in fish culture. It is influenced by temperature, partial gas pressure (elevation/altitude) and salinity (Boyd & Licthkoppler 1982). According to Cholik *et al.* (1986) and Sunarti (1992), fish become inactive and growth is limited if DO concentration in culture media is lower than 3 mg/L for prolonged periods. Measured DO levels in waters off Muna Island during the present study varied between 4.2 – 7.9 mg/L. Generally, DO lower than 5 mg/L were measured in sampling stations of existing mariculture activities nearer the coastline, while better DO concentration (>5 mg/L) mostly recorded at sites further out from the shoreline. It is assumed that areas near the shoreline are influenced more by anthropogenic activities and natural events, such as sedimentation and high turbidity which can lower the DO concentration. With a Storet index value of -2, DO levels in waters around Muna Island are rated as moderate to highly suitable for mariculture.

Salinity

Salinity variation occurs in coastal areas due to tidal changes, freshwater run-off from nearby land and evaporation. The range of salinity levels that is considered optimal for mariculture is different between species. Salinity levels in waters off Muna Island range between 32.1 – 33.6 mg/L (ppt), and are considered optimal for existing mariculture activities (KLH, 2004). Based on Storet analysis, salinity levels in waters off Muna Island scored 0, with a rating of ‘good’ for mariculture activities in this region.

4.2. Kendari

Ten locations of existing mariculture activities within the Kendari region were measured for water quality condition (Table 9). The other two locations (Kandai and Lapulu) were not measured as they are considered market centers only, for transit of mariculture products. Anggoeya village has the poorest water quality condition because it is located on the inner side of Kendari Bay, closer to impacts of pollution from Kendari city. Storet values for water quality at the Kendari region sites are provided in Table 10

Table 9. Measured water quality in Kendari Bay (June-July 2010; -, no data)

No	Depth (m)	Temp (^{0}C)	pH	DO (mg/L)	Salinity (mg/L)	Clarity (m) (secchi)	TDS (mg/L)	Location
1	2.1	29.7	7.0	5.7	32.0	2.10	32.0	Bungkutoko
2	10.1	30.7	6.2	6.9	32.2	2.50	32.1	Bungkutoko
3	22.5	30.2	6.0	7.0	32.3	4.00	32.2	Bungkutoko
4	5.4	30.2	6.1	6.5	33.0	3.50	32.9	Bungkutoko
5	23.6	29.9	6.1	7.0	33.0	5.00	32.9	Sambuli
6	30.6	29.7	6.0	7.3	33.0	6.50	32.8	Sambuli
7	23.2	30.0	6.0	8.5	32.3	3.00	32.6	Sambuli
8	18.5	30.0	6.0	7.0	33.1	4.00	33.0	Tondonggeu
9	30.3	29.9	6.0	6.5	33.1	6.00	32.9	Tondonggeu
10	16.0	30.4	6.0	6.4	33.2	2.25	33.1	Anggoeya
11	2.1	29.7	7.8	5.1	30.0	2.10	-	Bajo Indah
12	10.3	30.2	7.7	6.7	31.0	4.75	-	Bajo Indah
13	18.4	30.4	7.8	5.0	32.0	8.00	-	Bajo Indah
14	15.4	28.2	7.8	6.4	34.1	8.50	-	Bokori
15	5.0	31.0	7.3	4.8	31.0	4.00	-	Bokori
16	8.2	28.4	7.8	5.8	31.0	6.50	-	Bokori
17	17.3	29.9	7.7	4.7	30.0	7.50	-	Leppe
18	3.6	29.4	7.7	5.1	29.0	3.60	-	Leppe
19	20.6	29.7	7.8	5.0	30.0	8.00	-	Leppe
20	15.0	27.5	7.7	6.7	31.0	7.75	-	Mekar
21	4.1	26.5	7.7	5.8	31.0	3.50	-	Mekar
22	5.5	27.7	7.7	4.8	30.0	5.50	-	Mekar
23	18.5	29.8	7.8	5.3	31.0	8.00	-	Mekar Jaya
24	1.4	27.5	7.7	6.5	30.0	1.40	-	Mekar Jaya
25	11.6	29.7	7.8	5.5	30.0	5.00	-	Mekar Jaya
26	31.8	29.6	7.8	5.5	30.0	8.00	-	Tapulaga
27	16.0	29.7	7.8	6.1	30.0	3.50	-	Tapulaga
28	24.0	29.6	7.8	5.4	30.0	6.00	-	Tapulaga

Table 10. Storet score for measured water quality parameters in Kendari Bay

No	Parameter	Unit	Standard	Measured data			Score
				Max.	Min.	Ave.	
	Temp.	^{o}C	27-32	31	26.5	29.48	-1
2	TDS	mg/L	1000	33.07	31.97	32.65	0
3	Clarity (secchi)	m	>5	8.5	1.4	5.02	-1
4	pH		7-8.5	8.28	6.36	7.17	-1
5	DO	mg/L	>5	8.51	4.65	6.04	-1
6	Salinity	mg/L	30-35	33.3	29	31.36	-1
Total Score							-5

Source: Centre (1977); Kepmen KLH N0. 115 (2003)

All other surveyed sites were located in outer Kendari Bay, where impacts of development from Kendari city such as high sedimentation and pollution are less apparent. It is considered that outer Kendari Bay is a suitable location for mariculture, as shown by the relative success of existing activities in the area. It is also verified by the Storet analysis (Table 10) where it scored an overall total of -5, which is the optimal score of the Index.

Temperature

Temperature variation within Kendari Bay is very similar to that of other locations in SE Sulawesi, ranging between 29.5 – 31 ^{o}C. Storet analysis shows that Kendari Bay achieved an overall Index score of -1, which rates the area is suitable for existing mariculture activities.

Water Clarity

High sedimentation leading to a decline in water clarity is a major concern in Kendari Bay, particularly within the inner area adjacent to the city. The unique geographic formation of the Bay resembles a bottleneck, which has compounded the problem with water clarity due to a lack of flushing effect, especially in the inner part. In the present study of mostly sites in outer Kendari Bay, water clarity (as measured by secchi) ranged between 1.40 – 8.50 m, with an overall Storet Index score of -1, which rates the area suitable for existing mariculture activities, especially for seaweed. This storet score is only valid for the outer part of Kendari Bay and not the inner part. Indeed, the government has banned any further farming activities inside the Bay to avoid user conflict with increasing traffic of sea transportation in and out of the Bay.

Depth

The inshore area of Kendari Bay is characterized by a relatively shallow seabed, with most mariculture activities located in water depth of between 2.1 – 30.6 m. Some places in Kendari Bay can be as deep as 150 m, and seaweed farming is the only mariculture activity which can be placed in the deeper waters further from the shoreline of the Bay.

pH

Measured pH values around Kendari Bay ranged between 6.4 – 8.3. Storet analysis has given a -1 score for the area, which rates it as suitable for mariculture activities, especially for seaweed farming.

Dissolved Oxygen

DO values ranged between 4.7 – 8.5 mg/L. This condition is regarded as 'good' for any mariculture activities, following the standard of water quality for mariculture published by KLH (2004) where DO is considered optimal if its above 5 mg/L. Storet index value of -1 in Kendari Bay rates DO as 'good' for mariculture.

Salinity

Range of salinity of the waters within Kendari Bay is between 29.0 - 33.3 mg/L (ppt), and considered optimal for mariculture activities. Although two relatively big rivers and several small streams discharge into the inner area of Kendari Bay, salinity in the outer area does not fluctuate widely. Storet index value of -1 for salinity rates outer Kendari Bay as 'good' for mariculture.

4.3. Buton Region

Most mariculture activities around this region are concentrated along Buton Strait and along the coastline of Muna Island that belongs to Buton Regency. The combination of a dispersed coastal population, limited sea transportation traffic and fewer, large-scale industries means this area is still in a relatively natural state compared to the other locations in the Province. However, relatively high sedimentation was observed during the present study, which was caused by active water turbulence driven by the easterly monsoon winds along the Buton coastline that faces Arafura Sea. Suspended sediments are predicted to be highest during this period, as was evident by consistently low water clarity in the area closest to the coastline. This might partly explain the reason why seaweed farming, which is more tolerant of variable water quality conditions, has gained more prominence compared to the other mariculture activities. Increasingly, more people have started or switched to seaweed farming of recent times, and Buton Island is now virtually surrounded by seaweed farming. Although most of the Buton coastline visited

during the present study was shown to have relatively low water clarity due to high sedimentation, locations along the coastline of Buton Strait still have optimal water quality conditions. Pearl oyster farms which require optimal water quality can be found in this area, although they have increasingly been surrounded by seaweed farming.

Measured water quality parameters on mariculture locations around Buton Island are presented in Table 11, and associated Storet Index values in Table 12.

Temperature

During the present study, water temperature in this region varied between 26.4 – 31.9 ^{0}C, with an average of 28.9 ^{0}C. The overall Storet Index score for water temperature in the area is -1, which rates the Buton region as suitable for mariculture. Most areas have stable water temperature, although some locations near the mouths of rivers and coastal straits are likely to be periodically affected by sudden temperature drops caused by large addition of freshwater from monsoonal rains and/or cooled oceanic seawater from tidal exchange. For example, a water temperature of 26.4 ^{0}C was recorded around Boneoge village during the present study, arguably caused by cooled water from the open sea passing into Buton Strait.

Water Clarity

Sedimentation causing reduced water clarity poses the higher risk to existing mariculture activities in Buton, especially for species that have a narrow tolerance of water quality variation such as pearl oyster. In the present study, water clarity was poor at some sites, varying between 1 – 11.2 m, with an average of 6.0 m. The overall Storet index value for water clarity was -1, which is adequate, although further study is required if mariculture is proposed in one particular area. East monsoonal winds caused water turbulence resulting in high turbidity on the east coastline of Buton Island. The western coastline is relatively protected during this season because it is located within Buton Strait. Therefore, most of the existing mariculture locations in this area have relatively good water clarity.

Depth

In general, most mariculture structures in Buton are built in shallow waters (e.g. for seaweed farming), although areas with deep water are also used if the mariculture construction can be adapted (e.g. floating net cages). The range of depths around existing mariculture activities in this region varies between 1 – 53.8 m.

pH

Measured pH values around existing mariculture locations in Buton are between 7.2 – 7.9. The overall Storet Index score for pH values in the Buton region is 0, meaning that the water quality rating is 'good' (Class B; has not been polluted) for existing mariculture activities around Buton Island.

Dissolved Oxygen

DO values around Buton Island varied between locations during the present study. Existing mariculture locations within bays and inlets, such as Wajugo (Lasongko Bay), had lower DO levels compared to the other areas located within straits or areas with good water movement/current, such as Palabusa and Bone-bone. Overall, DO variations around Buton Island are within the standard required by any cultured species in this region, ranging between 3.7 – 9.7 mg/L. It is important to acknowledge that some species need higher DO concentration than other species, and not all parts of Buton Island have waters with adequate DO levels.

Salinity

Salinity varied between locations in Buton Island during the present study, ranging between 28 - 31 mg/L, which is acceptable for existing mariculture activities. However, one sampling station at Katilombu village had salinity of 14 mg/L, well below the average for the Island as a whole. This location is surrounded by hills, and elevated run-off from a nearby river flowing into the area has made the salinity level drop to almost half of the standard of other locations. Salinity level is expected to return to background levels once normal river flows resume.

Table 11. Measured water quality in Buton region (June-July 2010; -, no data)

No	Depth (m)	Temp (^{0}C)	pH	DO (mg/L)	Salinity (mg/L)	Clarity (m) (secchi)	TDS (mg/L)
1	53.8	27.4	7.8	6.5	29.0	15.00	Bone-bone
2	32.7	26.4	7.8	6.9	29.0	15.00	Bone-bone
3	2.1	28.3	7.9	9.7	28.0	2.10	Bone-bone
4	2.1	28.2	7.8	5.1	30.0	2.10	Boneoge
5	20.0	27.8	7.7	4.7	30.0	2.00	Boneoge
6	9.1	28.2	7.8	5.4	30.0	9.10	Boneoge
7	45.0	29.1	8.1	6.8	29.0	5.25	East Lambusango
12	-	-	-	-	-	-	Holimombo
13	25.0	27.5	8.6	3.6	29.0	4.00	Kamelanta
16	23.1	28.1	7.8	5.4	30.0	12.00	Karae
17	10.6	27.9	7.2	6.6	30.0	10.60	Karae
18	46.7	28.1	7.8	4.1	30.0	10.60	Karae
19	20.0	28.1	7.7	7.5	14.0	4.50	Katilombu
20	30.0	27.9	7.8	6.6	28.0	4.50	Katilombu
21	26.0	27.9	7.8	6.7	28.0	4.50	Katilombu
22	2.1	27.9	7.7	3.4	31.0	2.10	Lalole
23	2.0	28.0	7.8	3.0	30.0	2.00	Lalole
24	21.3	27.8	7.7	4.0	31.0	12.00	Lalole
25	1.0	29.6	7.6	4.4	31.0	1.00	Lasalimu
26	5.0	31.9	7.8	6.9	32.0	5.00	Lasalimu
27	1.0	30.9	7.9	8.6	31.0	1.00	Lasalimu
28	2.1	29.1	7.8	4.9	29.0	4.00	Lolibu
29	3.5	29.3	7.6	4.0	30.0	2.50	Lolibu
30	5.0	29.0	7.8	5.8	29.0	4.50	Lolibu
31	3.0	29.6	7.7	4.4	31.0	2.50	Mawasangka
32	1.7	30.7	7.8	5.6	29.0	1.50	Mawasangka
33	3.0	29.8	7.8	3.7	31.0	2.50	Mawasangka
34	16.2	28.3	7.9	6.6	31.0	8.00	Palabusa
35	6.8	29.8	7.8	8.0	32.0	6.80	Palabusa
36	14.6	29.4	7.8	7.3	31.0	8.00	Palabusa
37	20.6	29.1	7.8	6.6	30.0	8.00	Pulau Makassar
28	33.4	29.1	7.8	5.5	29.0	8.00	Pulau Makassar
39	9.0	29.0	7.8	6.9	30.0	7.50	Pulau Makassar
40	20.9	28.2	7.7	3.5	31.0	12.00	Sulaa
41	15.1	28.2	7.7	4.1	29.0	12.00	Sulaa
42	23.9	28.5	7.8	4.8	31.0	12.00	Sulaa
43	15.2	29.0	7.7	6.3	29.0	6.70	Tobea
44	10.9	27.9	7.8	5.8	30.0	7.00	Waara
45	2.1	28.3	7.8	6.7	30.0	2.10	Waara
46	10.7	28.0	7.8	7.2	30.0	8.00	Waara
47	4.9	29.7	7.7	3.7	31.0	3.50	Wajugo
48	2.3	29.7	7.8	7.2	31.0	2.00	Wajugo
49	8.2	29.6	7.7	3.9	31.0	5.00	Wajugo
50	4.5	29.0	7.7	4.1	31.0	4.50	Wakambangura
51	1.0	30.7	7.7	5.5	30.0	1.00	Wakambangura
52	11.2	28.9	7.8	4.3	30.0	11.20	Wakambangura
53	1.5	28.2	7.7	7.7	30.0	1.50	Lowu-lowu
54	8.25	28.9	7.8	5.8	30.0	8.00	Lowu-lowu

Table 12. Storet score for measured water quality in Buton (June-July 2010)

No	Parameter	Unit	Standard	Measured data			Score
				Max.	Min.	Ave.	
1	Temperature	^{o} C	27-32	31.9	26.4	28.89	-1
2	Clarity (secchi)	m	>5	11.2	1	5.97	-1
3	pH	-	7-8.5	7.88	7.18	7.74	0
4	DO	mg/L	>5	9.67	3.74	5.63	-1
5	Salinity	mg/L	30-35	31	29	30.00	-1
Total Score							-4

Source: Centre (1977); Kepmen KLH N0. 115 (2003)

4.4. Summary

During the present study, all surveyed locations in SE Sulawesi showed relatively optimal water quality conditions. All sampling stations were adjacent to existing mariculture activities, highlighting the fact that experienced producers can mostly determine the best place to site their farms. However, a singular, 'spot' measurement of water quality is limited for many parameters and can only be used for estimation of the water condition at a particular site at a point in time. Moreover, there are more potential areas for mariculture development that have not been examined for their water quality condition, although the local government has announced that those areas are highly suitable for any type of mariculture activities.

Therefore, it is suggested that at a minimum, a twice annual time series of measurement of water quality representing wet and dry seasons, with additional water quality parameters such as nitrite, phosphate, pesticide and heavy metal concentration, should be performed to depict more reliable water quality conditions of the area. Other potential areas identified by local government as suitable for mariculture. Activities should also be measured to determine suitability and capacity to support any proposed mariculture development.

5. CONCLUSIONS

Based on the results of the present study, the following conclusions and recommendation are made:

- Three big clusters of existing mariculture activities are located in Kendari, Muna and Buton areas, collectively serving as both a source of mariculture products and a market destination or transit location.
- Most mariculture production in SE Sulawesi is based on traditional practices.
- All surveyed locations of existing mariculture activities in SE Sulawesi show relatively optimal water quality conditions.
- A lack of financial support, knowledge, skill, market information and institutional support has prevented farmers from enhancing their livelihoods and wellbeing through mariculture activities alone.
- Site capacity and suitability analysis of existing or potential areas of mariculture activities and development have largely not been considered by stakeholders involved in managing coastal areas, resulting in crowded and unmanaged development with multiple overlapping economic activities in some areas.
- Sensitive mariculture activities can be forced out from areas due to environmental and amenity impacts from other conflicting activities.
- Locations with no land transportation (small islands) or geographically far from capital cities have longer supply chain for products, with reduced profit margins as a result.
- Piloting of integrated ‘value-adding’ mariculture industries (e.g. raw material, processed products and ‘ready to eat’ industries) might help ease some if not all of the existing economic problems of the mariculture sector.
- Twice annual time series of water quality measurements representing wet and dry seasons is required to depict the real condition of water quality in SE Sulawesi, for both existing and proposed areas for development.

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Australian Government

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Mapping Survey, Situation Analysis and Characterisation of Mariculture Supply Chain in SE Sulawesi

A Collaboration Between

Fisheries Faculty, Haluoleo University, SE Sulawesi

Indonesian Centre for Marine and Fisheries Socio-Economic Research

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Contents

1 INTRODUCTION

Background

Indonesia is a large country with diverse fisheries resources spread across 33 provinces. In the national economy of Indonesia, the contribution of the fisheries sector to Indonesia's Gross Domestic Product, not including oil and gas, on average ranges between 1.9-2.0 % each year[1]. Although the fisheries sector share of Indonesia's economy is relatively low, it is considered to be one of the key primary industries sectors which have potential to increase contribution to household income, provide job creation and be a source of new export earnings for Indonesia's economy. Table 1 summarises the key types of activity in the Indonesian fisheries sector.

Table 1. Indonesian Fisheries Production, 2003-07

Types of Fisheries		Year				
		2003	2004	2005	2006	2007
Capture Fisheries (%)						
	Marine capture fisheries	74,1	70,6	64,2	60,3	57,9
	Open water fisheries	5,2	5,4	4,3	3,9	3,7
	Sub Total	79,3	76,0	68,5	64,2	61,5
Aquaculture (%)						
	Mariculture	**4,2**	**6,9**	**13,0**	**18,2**	**19,6**
	Brackishwater pond	8,5	9,1	9,4	8,4	9,0
	Freshwater pond	4,8	4,7	4,8	5,1	5,5
	Pen/Cage	0,7	0,9	1,0	0,8	0,8
	Floating Cage	1,0	1,0	1,6	1,9	2,1
	Rice (+ fish) field	1,6	1,4	1,8	1,4	1,5
	Sub Total	20,7	24,0	31,5	35,8	38,5
Total (Tonnes)		**5,915,988**	**6,119,732**	**6,869,543**	**7,488,708**	**8,031,230**

Source: Ministry of Marine and Fisheries Affairs (2007)

Total production of Indonesian fisheries was 8,031,230 tonnes per annum in 2007, including 61.5 % from capture fisheries production and the rest from aquaculture activities. For aquaculture, the major contribution is from the mariculture sector, which has increased from 4.2 % in 2003 to 19.6 % in 2007. Meanwhile, the contribution from other aquaculture

[1] Indonesian Government Statistics, 2007

production activities, including brackishwater pond, freshwater pond, pens/cages, floating cages and rice (+ fish) fields is realtively minor and stable by comparison over the same period. Marine capture fisheries remains the core fisheries activity in Indonesia, but production has declined steadily over the last five years. Mariculture production is now the second most important sector in terms of overall production.

It is believed that the role of mariculture activity will continue to play an important role in Indonesia's economic future given the potential accessibility of a wide coastal area that can be used to support production. On the other hand, the development of Indonesia's mariculture industries faces many constraints, including:

- Uncertainty over access, allocation and property rights of mariculture production areas
- Limited entrepreneurial involvement and infrastructure on the production side
- Most mariculture activities are based on traditional technology and deemed to be 'unbankable' by investors.

The growth of the mariculture sector in Indonesia has followed increasing global market demand for mariculture products in general, and pricing of these products has effectively determined the type of mariculture activity. The decline in wild catch from marine fisheries as well as in production from brackishwater ponds in Indonesia's fisheries sector are other reasons why the development of mariculture activities in Indonesia has been promoted of recent times.

South-East Sulawesi is one of the key mariculture locations in Indonesia, with major expansion occurring over the last decade. Mariculture technololgy was first introduced to the area by inter-island traders in order to meet increased demand for the products from export traders in Jakarta and Surabaya. Most mariculture product from SE Sulawesi is sold in the form of raw material because the number of processing units is relatively limited and they are located primarily in Jakarta and Surabaya.

The Present Study

The main objective of the present study is to undertake a survey of the mariculture industry sector and key stakeholders in SE Sulawesi, to conduct a situation analysis and to characterise the existing mariculture supply chains for selected key products. Target areas

for the survey, based on understanding of key production centres, are Kendari, Buton and Muna. Key products of interest, based on existing importance and/or potential for high value mariculture production, include seaweed, lobster, grouper, pearl oyster, abalone and sea cucumber. Other objectives include determining the pricing and costing of products, technologies applied and the broader socio-economic characteristics of key stakeholders, including producers, collectors and traders.

This study is part of the larger project funded by the Australian Centre for International Agricultural Research (ACIAR) (SMAR/2007/225) entitled "Assessing Mariculture Market Constraints and Potential in SE Sulawesi". This report presents the findings of this study, which are intended to be incorporated into the final report for the ACIAR project. The design of the survey was based in part on the outcomes of the ACIAR project planning workshop for sustainable mariculture production in SE Sulawesi conducted on 23 January 2008 in Kendari. The purpose of the workshop was to identify opportunities and constraints and stakeholders needs for mariculture development in the Province.

2 SURVEY DESIGN and METHODS

Survey Location

The survey of mariculture supply chains in SE Sulawesi was conducted in three locations: Kendari Bay, Muna and Buton. The selection of these locations was based on various conditions, including the areas where most mariculture activity is already underway, and where opportunity and/or issues exist for future development. Kendari Bay is a location immediately adjacent to Kendari, the major urban centre in SE Sulawesi. It is a relatively well developed embayment with one inlet and outlet to the sea. Recently this area has faced the problem of water quality degradation due to rapid urban/peri-urban development. The survey was based on the mariculture activities located in the outer Kendari Bay area, adjacent to the numerous coastal villages along the coastline. Muna and Buton Islands are the mariculture locations in SE Sulawesi with the best quality water and scope for major expansion, as they provide an expansive water area for potential mariculture activities and industry development.

Data Collection and Reporting

The survey was undertaken by the Fisheries Faculty, University of Haluoleo (Univ. Halu.), Kendari, SE Sulawesi, based on a design developed in collaboration with the Indonesian Centre for Marine and Fisheries Socio-Economic Research (ICMFSER), Network of Aquaculture Centres in Asia-Pacific (NACA) and Department of Primary Industries, Fisheries Victoria (DPIFV). Questionnaires (attached) were developed in Bahasa language, based on nominal production, distribution and market stages of the supply chain. Data was collected by direct interview and collated from completed questionnaires, summarised and translated into English for analysis and reporting purposes.

Surveys were undertaken on two occasions in Kendari Bay, in August and December, 2008. One-off surveys were undertaken in Buton and Muna in August, 2008. For each survey, representative village-based fisher/farmer groups were randomly identified in advance based on existing anecdotal knowledge and logistical considerations. The same respondents were interviewed for the repeat survey in Kendari Bay. Univ. Halu. survey teams were trained for

an initial one week period at the commencement of the survey under the direction of the ICMFSER. Quality control for data entry and analysis was under the joint supervision of the ICMFSER, Univ. Halu and DPIFV. The number of survey respondents was determined to be relatively proportionate with the scale of production for the respective products and areas. Approximately 7-10 days was allocated for each survey event/location, based on multiple survey teams of two persons undertaking the interviews

Data Type and Analysis

Both primary and secondary data were collected as part of this study, and data types are summarised in Table 2. As previously described, the primary data were collected by interview as part of the survey and are presented in this report. The secondary data were collected from local (provincial/district) Marine and Fisheries Offices (MFOs).

Table 2. The Primary and Secondary data collected as part of the survey for this study in outer Kendari Bay, Buton and Muna, SE Sulawesi during 2008.

Type of Data	Production Stage	Distribution Stage	Market Stage	Duration of collected
Primary Data	1. Business managerial skill (type of technology, input use, labour use, access to financial institution, etc). 2. Ecological condition along the cultivation area. 3. Input – output for growing activities. 4. Marketing Channel for those commodities. 5. Etc (see Questionnaire of Production)	1. Marketing Channel for those commodities. 2. Input – output for trade activities for those commodities. 3. The core of mariculture industry in local and regional market. 4. Current delivery system. 5. Etc (see Questionnaire of trade)	Standard of consumer need by commodities	One-off for total 10 days in August 2008 (all areas) and again in December 2008 (Kendari only)
Secondary Data	1. Data series of SE Sulawesi production for those commodities (2000 – 2007). 2. Data series of farming areas for those commodities (2000 – 2007) 3. Data series of inter-island trade for those commodities (2000 – 2007). 4. Data series for price of those commodities at farm and consumer level (2000 – 2007).	1. Monthly trade data for volume of that commodity 2006 – 2007. 2. Monthly price data for those commodities 2006 – 2007.	1. Standard of consumer need by commodities. 2. Etc (see Questionnaire)	May-August 2008

The Primary data will be used to analyses the competitive of marketing activities of SE. Sulawesi Mariculture Industry trough the following equations. The equation (1) represents sharing price recieve by each of the marketing channel for mariculture product. The equation (2) represent of marketing margin for each marketing channel. And Equation (3) represent total marketing margin.

$$S_h = \frac{Pj}{\Pr} \quad \text{.....} \quad (1).$$

$$M_p = \frac{(Pjp - Pjb)}{Pjp} \quad \text{.....} \quad (2).$$

$$M_T = \frac{\Pr - Pg}{\Pr} \quad \text{.....} \quad (3)$$

Where:

S_h = Share of price received by each marketing channel.

Pj = the selling price by each marketing channel.

Pr = the retailer price for the respective mariculture product.

M_p = Marketing Margin of each marketing channel.

Pjp = the selling price of the mariculture product by each marketing channel.

Pjb = the buying price of the mariculture product by each marketing channel.

M_T = Total marketing margin.

Pg = the price received at farm gate.

Those marketing margins are presented in this report as part of the calculation being used in the supply chain analysis to provide an indicative cost-benefit comparison for the key mariculture products and sectors presently in SE Sulawesi.

3 SE. SULAWESI MARKET CHARACTERISTICS

Survey Respondents

The industry and product profile, number and location of respondents participating in the survey in the present study are summarised in Table 3. The total number of respondents for all areas and products combined included 58 growers, 37 fishers, 32 local traders/collectors and 20 inter-island traders.

Table 3. Industry and product profile, number and location of survey respondents in SE Sulawesi during the study period ending December 2008.

Type of Mariculture	Type of Respondent	Locations				
		Kendari Bay	Muna	Buton	Total	
Seaweed	Grower	7	7	23	**37**	
	Local Village Trader	3	2	9	**14**	
	Inter Island Trader	2	-	6	**8**	
						59
Lobster	Grower	6	3	2	**11**	
	Local Village Trader	-	2	1	**3**	
	Inter Island Trader	1	-	-	**1**	
						15
Grouper	Fishermen	3	3	3	**9**	
	Grower	-	-	4	**4**	
	Local village trader	-	2	2	**4**	
	Inter island Trader	2	-	-	**2**	
			-	-		**19**
Sea Cucumber	Fishermen	6	5	5	**16**	
	Grower	-	-	1	**1**	
	Local village trader	-	2	4	**6**	
	Inter island Trader	2	-	3	**5**	
						28
Abalone	Fishermen	7	5		**12**	
	Local village trader	1	2	2	**5**	
	Inter island Trader	1	1	1	**3**	
						20
Pearl Oyster	Grower	-	-	5	**5**	
	Inter island Trader	-	-	1	**1**	
						6
Overall Total		**41**	**34**	**72**		**147**

Market Characteristics

In general most mariculture products from SE Sulawesi are sold for both local and export markets as raw material; live, fresh or chilled fish products, semi-dried in the case of seaweed, and otherwise un-processed.) It is estimated that only approximately 10% of SE Sulawesi mariculture production (especially fish) is distributed via 'small' (local, village and town-based) collectors and traders via the local 'wet' market and associated food stalls and local vendors. The remaining majority of products are distributed via 'big' (town/city-based) collectors and inter-island traders to primarily Asian export markets through Makassar, Surabaya and Jakarta. Export markets vary with products, but include primarily Hong Kong and other parts of China, Taiwan and Singapore.

Some mariculture supply chains in SE Sulawesi are relatively simple. The supply chain for Pearl Oyster for instance is controlled by a single trader due to the specific market needs, high technology applied and relatively high unit value of the product and associated operational costs. Other mariculture products have more complicated and elongated supply chains. Sea weed and sea cucumber typically distribute through the local village trader or the inter-island trader after limited processing via solar drying to stabilise the product. Lobster, grouper and abalone are mostly sold live to the inter-island trader or direct to international markets or fresh and chilled to the inter-island trader for domestic market in Jakarta, Surabaya and Makasar, with some abalone also sold as semi-dried product to local traders for domestic markets. Most of the mariculture products from the local village traders in Buton are sold directly to Makasar by the inter-island trader. Products from Muna and Kendari typically go to markets in Kendari and/or on to Makassar and Surabaya, including those destined for export. Kendari is seen to play an important role presently and in the future for distribution of mariculture product from Muna island, while Buton is expected to continue to send mariculture products directly to Makasar for logistical convenience.

The on-farm price of various mariculture products exported from SE Sulawesi are mostly determined by the fluctuation of the prices in destination markets, especially Hong Kong and Singapore, which in turn are related to usual supply/demand dynamics i.e. prices drop with increased production levels, and vice versa. In general, it is apparent that SE Sulawesi producers are primarily price 'takers' rather than price 'makers', due to limited and inconsistent volume of supply, and limited storage and processing capacity. At this early stage of development, all effort has been directly focussed on expanding the production end

of the supply chain in order to meet export market demand, with little effort placed on the post-harvest, value-adding end of the chain and in strategically developing mariculture as an agribusiness industry.

4 RESPONDENT CHARACTERISTICS

General survey information from respondents is considered to be characteristic of mariculture industry stakeholders in SE Sulawesi. This information covered variables such as age, education, experience on respective activities, family size and the amount of labour used, all reported in the context of key mariculture survey locations and species/products.

Kendari Bay

In Kendari Bay, the survey focused on five key commodities, including mariculture-based (M) and also wild catch fishery-based (F), but with potential for expanded production by adoption of mariculture technologies: sea weed (M), lobster (M), grouper (M/F), sea cucumber (F) and abalone (F). The general characteristics of survey respondents in Kendari Bay are summarised in Table 3.

Table 3. General characteristics of mariculture industry survey respondents for Kendari Bay, Aug/Dec., 2008

Location	Commodities	Types of Respondent	Age (year)	Education (year)	Experience (year)	Number of family	Labour	
							Family	Hired
Kendari	1. Sea weed	Grower	46.6	6.0	2.5	5.0	1.7	0.0
		Village Trader	39.0	10.0	20,0	4.0	2.0	2.0
		Inter Island Trader	36.0	11.0	8.0	5.0	2.0	13.0
	2. Lobster	Grower	37.7	10.0	1.8	3.7	1.2	4.7
		Inter Island Trader	35.0	12.0	8.0	4.0	1.0	10.0
	3. Grouper	Fishermen	33.5	9.0	12.0	5.0	1.0	4.0
		Grower	48.0	12.0	12.0	4.0	1.0	1.0
		Local village trader	29.0	14.0	5.5	3.0	1.0	4.0
		Inter island Trader	54.0	19.0	19.0	4.0	-	39.0
	4. Sea Cucumber	Fishermen	33,9	5.8	16.0	6.0	1.3	1.5
		Local village trader	44.0	12.0	20.0	4.0	2.0	2.0
		Inter island Trader	40.0	10.0	10.0	6.0	1.0	15.0
	5. Abalone	Fishermen	41.0	7.5	15.5	5.9	1.9	5.5
		Local village trader	44.0	12.0	20.0	4.0	2.0	2.0
		Inter island Trader	28.0	12.0	3.0	2.0	1.0	4.0

Source: processed from primary data, 2008

For seaweed, the stakeholder engage in the survey are growers, village (also referred to as 'small') traders (also referred to as 'collectors') and inter-island (also referred to as 'big') traders. The age of the respondents ranged from 36 to 46.6 years. Most of the growers in Kendari Bay finished elementary school, and are relatively recent entrants to the industry with an average of 2.5 years experience growing seaweed. Due to lack of capital, the growers tend to avoid hired labor in preference to using family labor. It is also noted that seaweed farming is an enterprise in which both male and female family members are actively involved. The village seaweed trader employs on average two persons, whereas the inter-island traders employ on average up to 13 persons, the latter also often having a permanent office space as the showroom and handling unit.

The lobster mariculture business in Kendari Bay is presently expanding, and typically involves only growers and the inter-island traders, with no village traders involved. Typically, both types of respondents have finished junior high school level of education. The average age of growers is 37 years, with 1.8 years experience and they employ on average 4.7 personnel. By comparison, the inter-island traders have about eight years experience and employ on average ten personnel for handling lobsters and getting them to the destination market.

The grouper business in Kendari Bay involves five types of respondents, including fishers who provide the wild-caught fingerling seedstock, growers who take the fish to consumption size, the local village traders who collect the live and fresh grouper from the grower in various locations in Kendari Bay, and the inter-island traders who buy from the village traders. Live grouper are sold mostly to export markets, and fresh grouper are sold to domestic markets, both locally in Kendari and also to Makassar, Jakarta and Surabaya. Most of the grouper respondents have the best education level in the mariculture industry for the Kendari area, and have relatively long experience ranging from five to 19 years in each of their respective activities. The inter-island trader in Kendari Bay can be classified as a pure commercial business because they employ all labour and do not rely on any family labour in the business.

The sea cucumber business in Kendari Bay is controlled by the fishers, local village traders and inter-island traders. Sea cucumber are wild caught and semi-processed (cleaned and dried) by the fishers before sale to the village traders and subsequently the inter-island traders. All of the three respondent groups have long experience with the wild fishery for sea

cucumber from coastal waters and with distribution to destination markets. Fishers and local village traders are classified as subsistence and small scale business enterprise respectively, and rely on mostly family labour. The fishermen and village trader typically have limited financial resources, with the inter-island trader being the only available source of financial aid. Inter-island traders can be classified as fully commercial business enterprise as they employ on average up to 15 personnel for handling and distribution of the product to market.

Abalone is presently collected by fishers from the coastal waters near Kendari. There are presently no mariculture producers of abalone in Kendari Bay. Fishers typically sell the abalone to the local village trader, who in turn plays an important role in gathering the abalone in various locations in Kendari Bay and then on-sell to the inter-island traders. All abalone respondents operate their activities with hired labor. The fishers and local village traders typically have long experience in the abalone business ranging from 15 to 20 years, but the single inter-island trader surveyed was noted as having limited experience. Only the inter-island trader has a linkage with the consumer market, and also is the only source of financial support for the fishers and village traders.

Muna Island

Muna Island and surrounding areas are believed to be the best place for mariculture activities in SE Sulawesi due to the good quality of water. In Muna, types of mariculture activities include sea weed, lobster, sea cucumber, grouper and abalone. There were no Muna-based inter-island traders operating in this area included in this survey, with the inter-island traders mostly located in Kendari. This is partly because the volume of mariculture production from Muna is limited in scale and seasonally dependent, and therefore not continuous at the present time. By comparison with Kendari, mariculture activities are still in the early stages of development. The major primary industry in Muna Island is presently the estate cropping of cashew nut and forest products, with mariculture seen to be of secondary importance for local communities. This is also partly due to the lack of a locally-based inter-island trader in Raha, the major centre in Muna. The general characteristics of survey respondents in Muna are summarised in Table 4.

Table 4. General characteristics of mariculture industry survey respondents for Muna, Aug. 2008

Location	Commodities	Types of Respondent	Age (year)	Education (year)	Experience (year)	Number of family	Labour	
							Family	Hired
Muna	Sea weed	Grower	40.0	7.0	5	4	1	2
		Village Trader	48,7	9.3	5	4.5	2	3.7
	Lobster	Grower	39.7	7.0	13	3.3	1	1
		Village Trader	45.0	12.0	9,5	3.5	2	2.5
	Grouper	Fishermen	41,5	6.8	12.3	3	2	1.7
		Grower	-	-	-	-	-	-
		Vvillage trader	36.0	8.0	7	3	1	1.6
	Sea Cucumber	Fishermen	40.5	6.5	10.5	4	2.6	1.7
		Local village trader	52.2	7.5	12.5	5.5	2.3	2.2
	Abalone	Fishermen	25.7	6	5.7	4.5	1	-
		Local village trader	46.3	8	4	7.3	2	4

Source: processed from primary data, 2008

At the production end, the average age of survey respondents in Muna ranged from about 25 years for abalone fishers to about 40 years for sea weed, lobster, grouper, and sea cucumber growers and fishers alike. Overall experience for growers, fishers and local village trader combined ranges from an average of five to 12 years, and mostly family labour is employed as mariculture is mostly practised on a small economic scale.

Buton Island

Buton Island and surrounding small island areas have much the same variety of mariculture enterprise as Muna and Kendari, although with the major difference being that Buton also has a substantial pearl oyster farming sector. The latter is dominated by a single company operating in SE Sulawesi as a joint venture between a local company and foreign investors. This company employs about 250 personnel to support their activities. The company also has the function of a single inter-island trader for distributing pearl oyster products from Buton to market.

The Butonese were the first community to cultivate seaweed in the coastal waters of SE Sulawesi. All of the seaweed and most of the other mariculture products from Buton and surrounding areas are typically sent directly to Makassar as a centralised hub for Buton's commercial mariculture trade, prior to distribution through local and export markets. The general characteristics of survey respondents in Buton are summarised in Table 5.

Table 5. General characteristics of mariculture industry survey respondents for Buton, Aug. 2008

Location	Comodities	Types of Respondent	Age (year)	Education (year)	Experience (year)	Number of family	Labor	
							Family	Family
Buton	Sea weed	Grower	46.8	5.2	6.9	6.7	3.1	6.4
		Village Trader	42.6	6.5	3.3	6.1	1.9	0.0
		Inter Island Trader	39.3	10.7	8.2	4.4	1.9	6.0
	Lobster	Grower	35.0	14	8.5	6.0	1.0	1.5
		Village Trader	43.0	0.0	11.0	12.0	10	7.0
	Grouper	Fishermen	32.7	5.0	14.3	4.7	2.3	2.0
		Grower	46.8	7.8	9.5	7.5	1.0	2.3
		Local village trader	42.5	6.0	14.5	9.0	5.5	3.5
	Sea Cucumber	Fishermen	48.0	1.2	27.2	5.2	1.8	-
		Grower	62.0	6.0	10.0	9.0	1.0	3.0
		Local village trader	41.0	4.5	12.5	7.5	5.5	0.0
		Inter island Trader	41.4	9.6	6.4	5.4	1.4	3.0
	Abalone	Fishermen	-	-	-	-	-	-
		Local village trader	34.0	0.0	9.0	7.5	6.0	0.0
		Inter island Trader	37.0	12.0	6.0	3.6	1.3	5.0
	Pearl Oyster	Grower	47.2	10.5	9.0	6.0	2.5	5.2
		Inter Island Trade	51.0	12.0	7.2	9.0	3.0	250

Source: processed from primary data, 2008

The local market demand for mariculture products remains relatively low in Buton due to the limited population number and relatively high prices. Survey respondents typically have long experience in their own business, ranging from three to 27 years. In Buton the inter-island traders of seaweed and abalone and village traders of lobster employ the most personnel to support their activities.

5 SUPPLY CHAIN ANALYSIS

This section of the report describes the existing mariculture supply chains in SE Sulawesi for each of the key products and study areas, based on survey results from the present study. The supply chains are described on the basis of the previously identified components of growers, fishers, village traders and inter-island traders, as appropriate. Product (weighted mean) price range estimates are provided at different stages of the chain, together with nominal % estimates of the breakdown of overall volume traded. These data are considered to be respectively indicative and relative estimates only, rather than absolute measures, and relevant to the survey time period in 2008.

Based on estimates of production cost and market prices from survey data, a simple cost-benefit analysis has been undertaken for each supply chain for each product to determine where the comparative value and associated economic advantage is presently within each of the three key components of producers (growers and fishers), village traders and inter-island traders. This provides one means by determining where the opportunities for future industry development are likely to have greatest impact.

Seaweed Supply Chain

The relatively short seaweed supply chain for SE Sualwesi is presented in Figure 1. Seaweed in Muna, Kendari and Buton is grown from seedlings (cuttings) selected from the growers own harvest and/or from other growers. Harvested seaweed is sold as a semi-dried raw product by the grower after being partially processed by solar drying. In Kendari, about 80 % of the seaweed is sold to local village traders with a price of about Rp. 14,400/kg, and the rest is sold directly to inter-island trader for a price of about Rp 15,000/kg. The large proportion of seaweed is sold to the village traders because they typically provide financial support to the growers to offset operational costs. In Kendari Bay, 100 % of seaweed from local village traders is sold to inter-island traders, of which about 10 % is distributed (for a price of about Rp 16,350/kg) through Surabaya, and about 90 % is distributed through Makassar (for a price of about Rp 16,375/kg).

In Muna the growers sell all the seaweed to the local village traders for a price of about Rp 16,000/kg. The local village traders sell their own seaweed to inter-island traders in Kendari (about 50 %, at a price of about Rp. 16,333/kg) and in Buton (about 50 %, at a price of about Rp 16,500/kg). In Muna, there is no direct seaweed distribution to Makasar or Surabaya as it all goes via Buton or Kendari.

In Buton the growers sell the seaweed to the inter-island traders (about 40 %, at a price of about Rp 16,500/kg) and the local village traders (about 60 %, at a price of about Rp 16,512/kg). All the local village trader's stock of seaweed is sold to the inter-island trader at a price of about Rp 16,687/kg. The inter island trader in Buton distributes 75 % of seaweed to Makasar for a price of Rp 20,200/kg and 25 % to Surabaya at a price of Rp 20,314/kg.

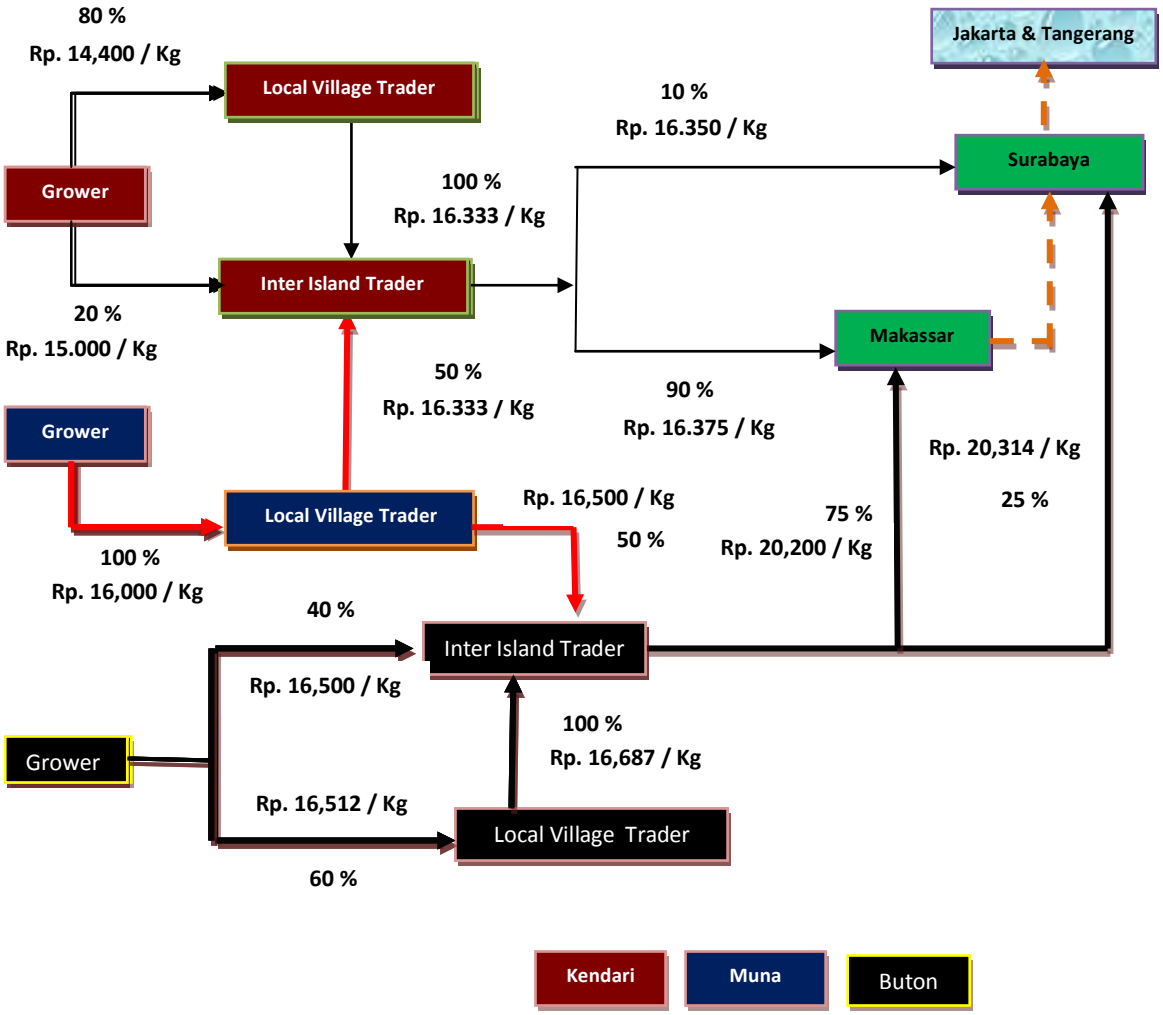

Figure 1. The Seaweed supply chain in SE Sulawesi, 2008

In SE Sulawesi, Makasar is the major market hub for distribution to the main domestic markets in Surabaya and Jakarta/Tangerang, where further processing takes place to manufacture carageenan chips for export.

Supply chain value analysis - seaweed

A summary of the value analysis for the seaweed supply chain (Fig. 1) in SE. Sulawesi is provided in Figure 2, and is based on the most common channels that the growers produce and sell their product.

Figure 2. The value analysis for seaweed supply chain in SE Sulawesi

For the seaweed supply chain in SE Sulawesi, total 'through chain' value added is estimated at about Rp 7,548/kg, based on an overall 'through chain' cost of about Rp 5,750/kg. To create this value, the grower incurs about 75.2 % of the cost in the chain, including processing the product into a dry condition, and in return receives the higher proportion of about 70.0 % of the added value. By comparison, the village traders get only 10.5 % of the added value but incur a relatively small share of the cost at about 11.1 % as they undertake no further processing or grading. The inter-island trader gains the best cost-benefit outcome by receiving about 19.5 % of the added value, but only incurring about 13.7 % of the overall costs, including the grading and storage of the product in their own warehouse.

Spiny Lobster supply chain

The relatively short supply chain of the spiny lobster in SE Sulawesi is presented in Figure 3. All spiny lobster cultured in SE Sulawesi are initially sourced as wild-caught sub-market size from local fishers, mainly from Muna (50 % of the seed to Kendari Bay and the rest shared between Muna and Buton). They are typically fattened in pens for 4-12 mths (depending on size) and sold as live product at market size for consumers. The fishers sell the seed (pieces/kg) to the growers at prices ranging from about Rp 218,000/kg in Muna to Rp 245,000/kg in Kendari. In Kendari the growers sell spiny lobster at final market (consumption) size to the inter-island traders at the highest price of about Rp 360,000/kg,

whereas growers in Muna and Buton sell finished product to local village traders at a lesser price of about Rp 275,000-285,000/kg. The village traders then sell various grades to the inter-island traders located in Kendari at a price of about Rp 300,000/kg. The grading for final sale into the wholesale market occurs at the inter-island trader stage, with first grade product sold in Denpasar and Jakarta, and second grade in Surabaya. The average selling price of spiny lobster for these markets is about Rp 470,000/kg. Although the price received by the inter-island trader is relatively high, they also incur higher costs (Rp 296,000/kg) to provide handling, paid labor and transportation to the destination market.

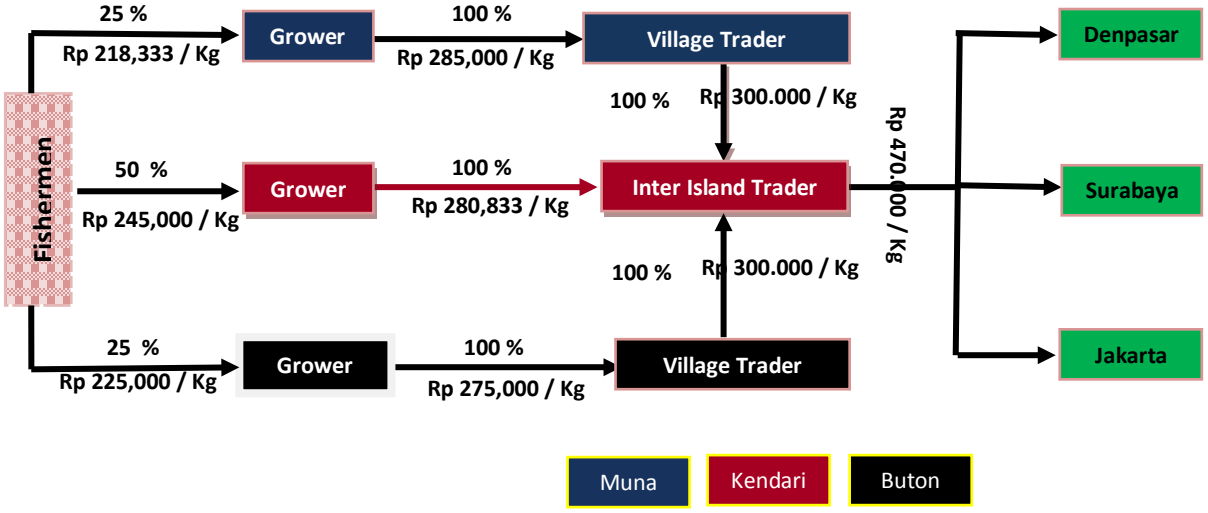

Figure 3. The spiny lobster supply chain in SE Sulawesi, 2008

Supply chain value analysis – spiny lobster

A summary of the value analysis for the spiny lobster supply chain (Fig. 3) in SE. Sulawesi is provided in Figure 4, and is based on the most common channels that the growers produce and sell their product.

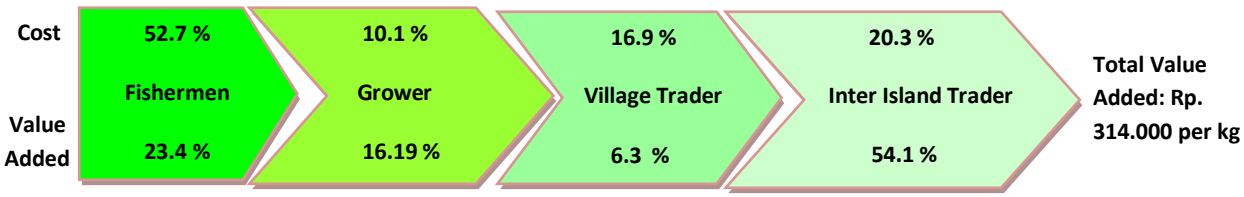

Figure 4. The value analysis for spiny lobster supply chain in SE Sulawesi

For the spiny lobster supply chain in SE Sulawesi, total 'through chain' value added is estimated at about Rp 314,000/kg, based on an overall 'through chain' cost of about Rp 296,000/kg. From the total added value, the inter-island trader receives the highest share of

value (54.1 %), with a cost share about 20.3 %. The higher cost includes labour for maintenance of live lobster and for grading prior to sale to the final markets.

By comparison, fishers gain an estimated 23.4 % of total added value but incur about 52.7 % of the overall 'through chain' cost of production for handling, maintenance and feeding. Growers gain an estimated 16.2 % of total value added but incur only 10 % of the production cost, based on costs for rearing a medium to premium lobster in two-three months before on-selling to the village trader. Major costs include feed and labour during the rearing period. Production costs vary with the size of seed, which is cheaper to buy for smaller size but feed and labour costs are greater due to the longer rearing period (up to 12 months). The share of added value and costs to the village trader is only 6.3 % and 16.9 % respectively, as they sell and buy various sizes of lobster without grading to minimise costs.

Grouper Supply Chain

The grouper supply chain for both mariculture and the wild fishery in SE Sulawesi is presented in Figure 5. The live groupers are sold mainly to export markets in Taiwan, Hong Kong and China, whereas fresh grouper are mostly sold to domestic markets.

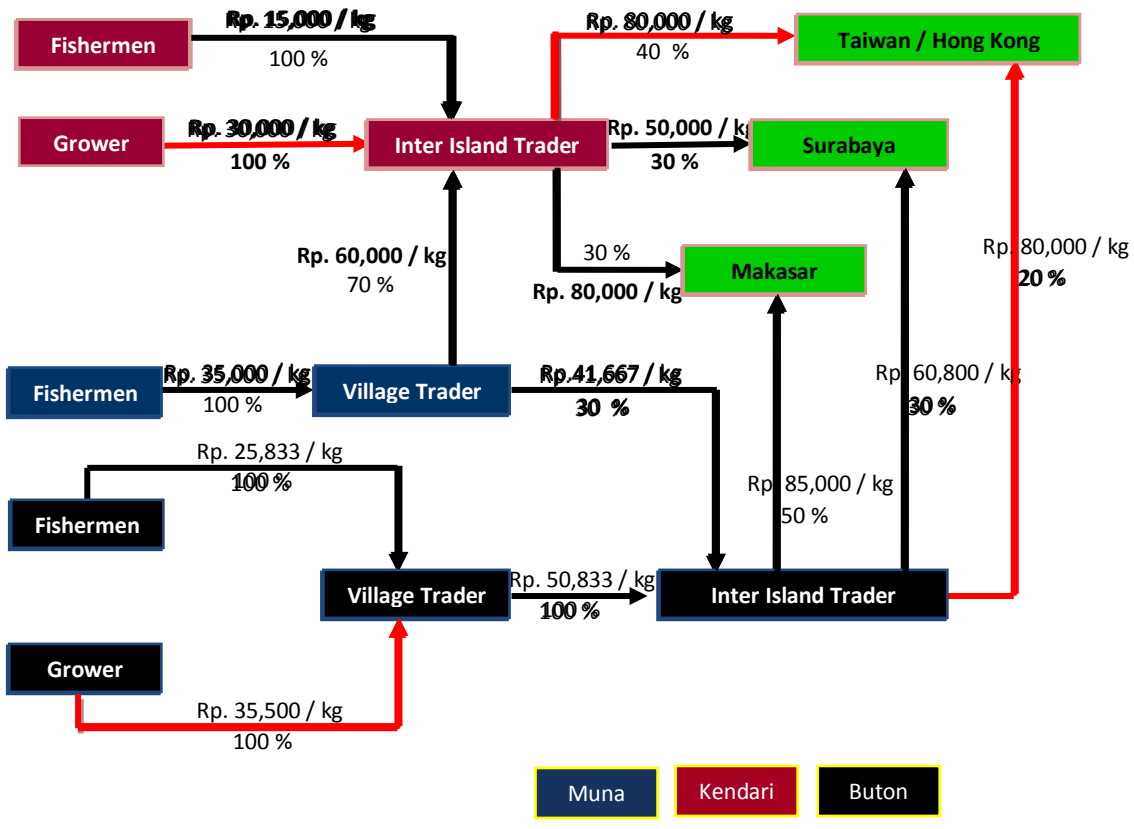

Figure 5. The grouper supply chain in SE Sulawesi, 2008

In Muna, the village fish traders buy 100 % of the consumption size fresh grouper from the fishers at the price of about Rp 35,000/kg, with no grading. They are then on-sold after grading to the inter-island traders in Kendari for premium size, and Bau-Bau (Buton) for medium size at difference unit prices based on graded size. The inter-island trader in Kendari sells graded groupers to overseas markets (40 %) and Makassar and Surabaya (30 % each). The inter-island trader buys fresh grouper directly from fishers at a price of about Rp 15,000/kg without grading, and the live, mostly premium size grouper at a price of Rp. 30,000/kg. The inter-island trader sells the premium live grouper to overseas markets in Taiwan, Hong Kong and China, and fresh grouper at medium and premium sizes to Surabaya for Rp 50,000/Kg and Makasar for Rp 80,000/Kg.

In Buton, fishers and growers sell fish to village traders in Bau-Bau. Growers sell live fish at a price of about Rp. 35,500/kg, while fishers sell mostly fresh fish without grading at a price of Rp. 25,833/kg. The village traders sell the ungraded grouper (live and fresh) to the inter-island traders, who then grading into medium and premium size. Live premium grouper are sold to Hong Kong and Taiwan (20 %) via the live haulage vessel export fish traders, and the fresh grouper are sold to domestic markets.

Supply chain value analysis – grouper

A summary of the value analysis for the grouper supply chain (Fig. 5) in SE. Sulawesi is provided in Figure 6, and is based on the most common channels that the growers produce and sell their product.

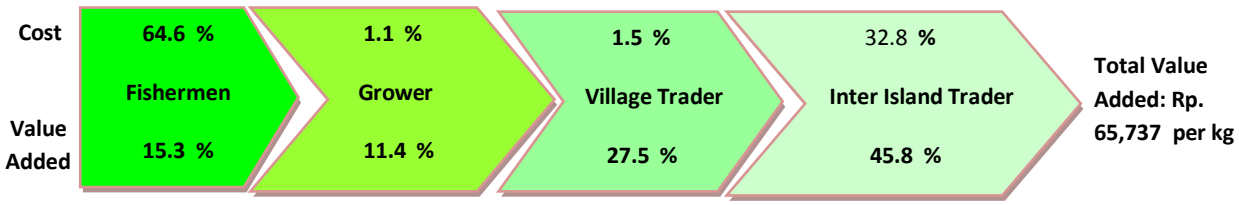

Figure 6. The value analysis for grouper supply chain in SE Sulawesi

For the grouper supply chain in SE Sulawesi, total 'through chain' value added is estimated at about Rp 65,737/kg, based on an overall 'through chain' cost of about Rp 15,939/kg. The inter-island trader gains the highest proportion of the estimated added value (45.8 %), with only 32.8 % of the total cost for each kg of the product; the major costs being for labour, grading and handling the grouper, as well as transportation of the product to the domestic market.

The fishers gain an estimated 15.3 % of the total value added, but incur about 64.6 % of the total cost for labor, vessel operation and maintenance, and handling the fish. The relatively low share of added value is primarily due to selling only ungraded product to village traders. By comparison, the growers receive an estimated 11.4 % of the added value for sale of mostly premium size grouper, and incur only about 1.1 % of the total cost, mostly for wild caught trash fish as feed and also for seed from hatcheries in East Java and Bali. The grower to get the maximum value added. Village traders gain an estimated 27.5 % of the added value and incur a cost of only about 1.5 % of the total, mostly for maintenance of live fish in oygenated water before on-selling to the inter-island traders (usually up to 30-50 kg weekly).

Abalone supply chain

The abalone wild fishery supply chain in SE Sulawesi is presented in Figure 7. Abalone are mostly captured by fishers from the coastal waters around small islands in Kendari Bay and surrounding small islands in Muna.

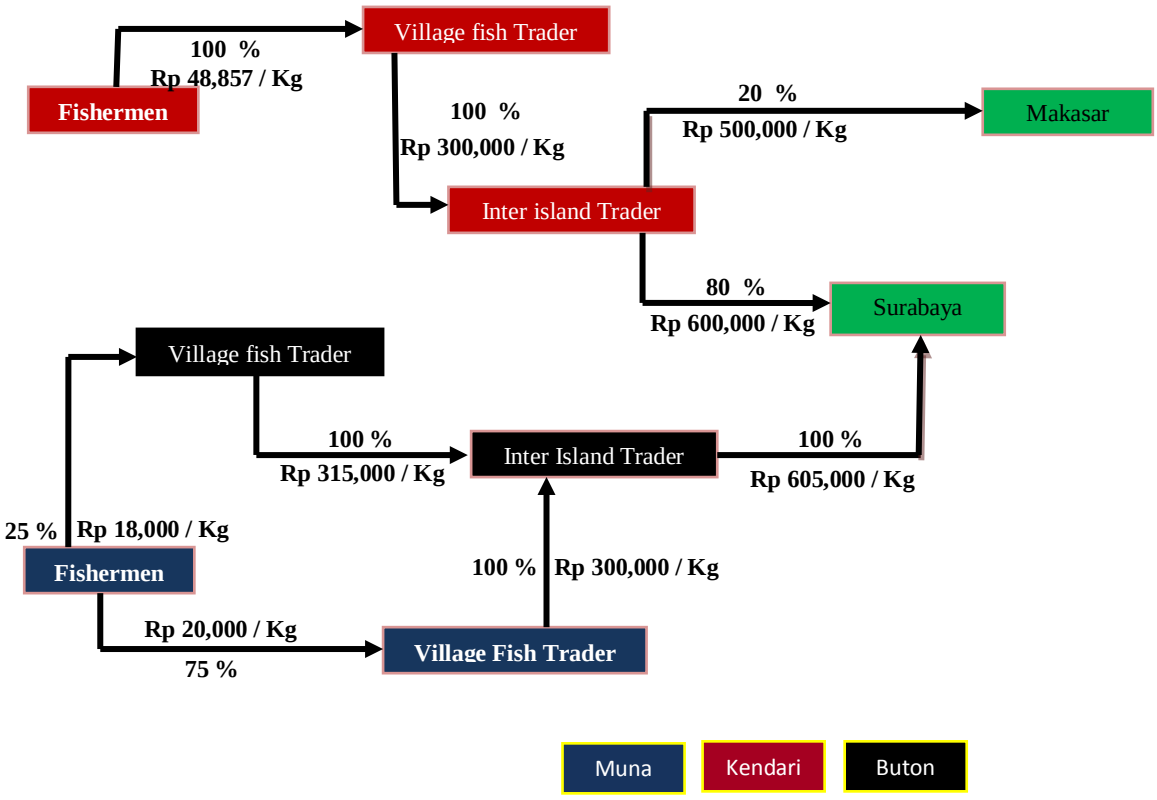

Figure 7. The abalone supply chain in SE Sulawesi, 2008

In Muna, fishers sell all abalone live, without grading, to a number of local, village traders in various locations in Kendari Bay, at an average price of about Rp. 48,857/kg, after which they are graded according to size and on-sold to inter-island traders in Kendari for prices up

to Rp. 300,000/kg. The inter-island traders sell the abalone to exporters in Surabaya (premium size; estimated about 80 % of trade) and Makasar (medium size; about 20%), at an average price of about Rp. 500-600,000/kg.

In Bau Bau (Buton), the village traders source small and medium size, ungraded abalone from fishers in Muna Island, with an average price of about Rp. 18,000/kg, but overall volume is relatively small. Buton's village traders on-sell the abalone to Buton's inter-island traders at an average price of about Rp. 315,000/kg, after processing and grading, after which all product is sold to exporters in Surabaya for an average price of about Rp, 605,000/kg.

In Muna, supplies of abalone mostly come from local fishers. They are sold to village traders, who process and grade the abalone and on-sell to inter-island traders in Bau-Bau (Buton) at an average price of about Rp. 300,000/kg.

Supply chain value analysis – abalone

A summary of the value analysis for the abalone supply chain (Fig. 7) in SE. Sulawesi is provided in Figure 8, and is based on the most common channels that the fishers produce and sell their product.

For the abalone supply chain in SE Sulawesi, total 'through chain' value added is estimated at about Rp 298,033/kg, based on an overall 'through chain' cost of about Rp 170,100/kg. It is estimated that fishers receive only about 3 % of total added value, with about 11.8 % of total cost for each kg, noting that this step involves collection of abalone from the sea and on-selling as live, ungraded product to village traders.

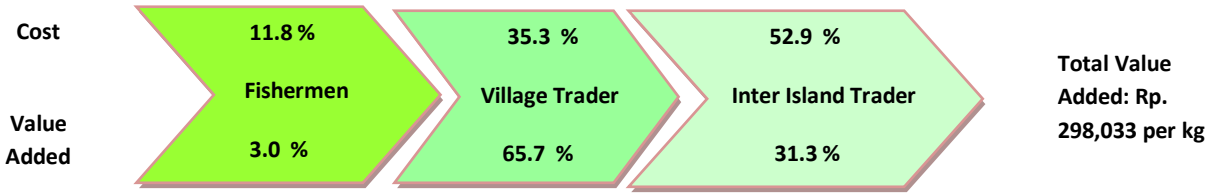

Figure 8. The value analysis for abalone supply chain in SE Sulawesi

Village traders receive the highest proportion of the added value (estimated 65.7 % of the total), with only 35.3 % of the total cost, which includes processing and grading prior to on-selling (typically 25-50 kg per month on average).

The inter-island traders receive an estimated 31.3 % of the total added value, for about 52.9 % of the total cost, which includes more advanced processing and handling prior to on-selling to exporters in Surabaya and Makasar. In SE. Sulawesi, it is apparent that the market for abalone is controlled by a relatively small number of traders.

Sea cucumber supply chain

The sea cucumber wild fishery supply chain in SE Sulawesi is presented in Figure 9. Although a small number of fishers in Kendari and Buton are known to have started to diversify into culturing wild-caught sea cucumber, the data in this survey represents mostly the wild fishery activity.

There are various species of sea cucumber selling in SE Sulawesi, from the lower priced and minimum quality, to the higher priced, premium quality. Price and quality of the different species is based on market perception of a combination of variables including size, colour, taste and texture.

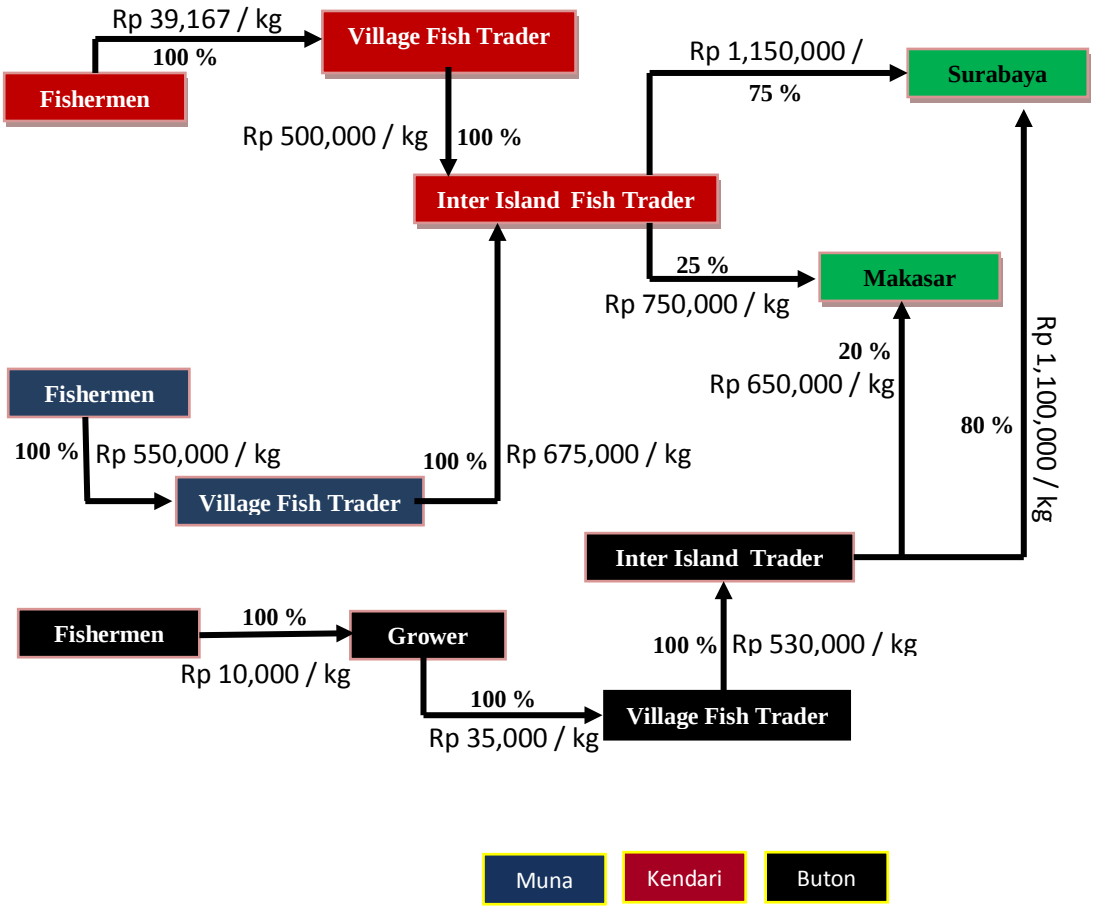

Figure 9. The sea cucumber supply chain in SE Sulawesi, 2008

In Muna, fishers collect and process mostly premium quality sea cucumber for sale to local, village traders at an average price of about Rp 550,000/kg, after which they are on-sold to inter-island traders in Kendari at an estimated price of about Rp 675,000/kg.

In Kendari, fishers sell various quality sea cucumber without grading to village traders at an estimated average price of about Rp. 39,167/kg. The product is then processed and sold, ungraded to the inter-island trader at an estimated average price of Rp. 500,000/kg. The inter-island traders grade the processed sea cucumber into premium and medium quality, with the former sold to exporters in Surabaya for about Rp. 1,150,000/kg, and the latter to exporters in Makasar for about Rp. 750,000/kg.

Fishers in Buton sell various species of live sea cucumber for seed to growers in Buton at a price of about Rp 10,000/kg. They are then grown for about 4-5 months and sold ungraded but as premium size to village traders at a price of about Rp 35,000/kg. Village traders process and handle supply to inter-island traders at a price of about Rp 530,000/kg. The inter-island traders grade the processed sea cucumber into premium and medium quality, with the former sold to exporters in Surabaya for about Rp. 1,100,000/kg, and the latter to exporters in Makasar for about Rp. 650,000/kg.

Supply chain value analysis – sea cucumber

A summary of the value analysis for the sea cucumber supply chain (Fig. 9) in SE. Sulawesi is provided in Figure 10, and is based on the most common channels that the fishers and growers produce and sell their product.

For the sea cucumber supply chain in SE Sulawesi, total 'through chain' added value is estimated at about Rp 665,700/kg, based on an overall 'through chain' cost of about Rp 454,400/kg.

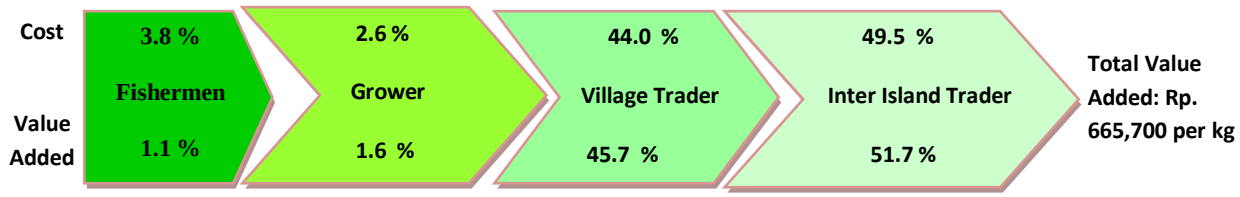

Figure 10. The value analysis for sea cucumber supply chain in SE Sulawesi

It is estimated that fishers receive only about 1.1 % of total added value, but for only about 3.8 % of the total cost. Fishers undertake only limited activity in sourcing the product initially from the wild fishery, and major costs are vessel operation and labor. In Buton, there are several growers who are estimated to receive about 1.6 % of total added value, for about 2.6 % of the costs, for fresh (un-processed) and ungraded sea cucumber.

It is estimated that village traders gain about 45.7 % of the total added value, for about 44 % of the total cost, including processing of dry but ungraded sea cucumber product. Inter-island traders process sea cucumbers into premium and medium qualities to maximise added value through sale to exporters in Surabaya and Makassar. They gain an estimated 51.7 % from the total added for about 49.5% of the total cost.

Pearl oyster supply chain

The relatively simple and short pearl oyster supply chain in SE Sulawesi is presented in Figure 11. In SE Sulawesi, pearl oyster culture is undertaken only in Sub District Kapuntori (Village: Lambusango Timur and Kamelanta) and Sub District Bungi (Village Palabusa) in Buton. This activity was first established about 70 years ago and is controlled by a single local company, PT. Selat Buton, but with affiliation with apearl export company located in Jakarta.

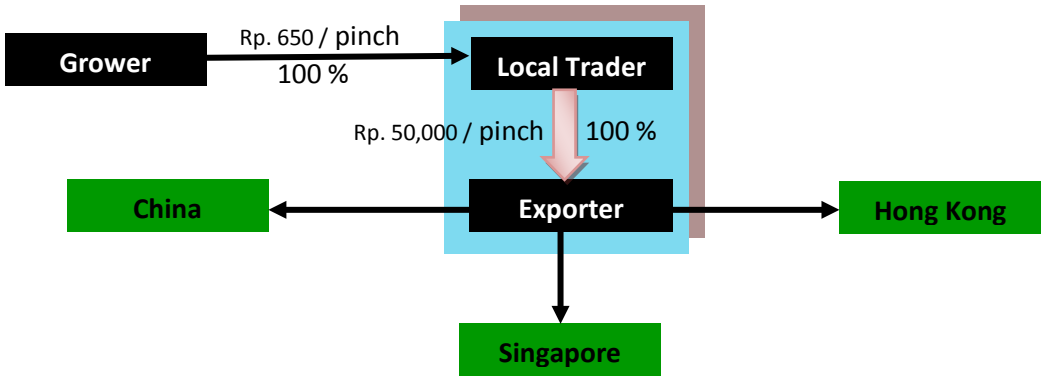

Figure 11. The pearl oyster supply chain in SE Sulawesi, 2008

Growers in Lambusango Timur, Kamelanta and Palabusa villages sell live pearl oysters to the local trader (PT. Selat Buton). The product is then sold to the Jakarta-based exporter, who provides technical assistance and capital support to the local trader and growers to ensure production of high quality product.

This market sector is strictly controlled due to relatively high investment cost and the need for application of specific post-harvest technologies. The market for pearl oyster is relatively small and targeted at high income groups. It is very difficult to get accurate data and information about price and quantity for pearl oyster production from the local trader and exporter in Jakarta due to commercial sensitivity. It is estimated that the local trader sells only to the Jakarta-based exporter at an estimated price of about Rp. 50,000/pinch.

Supply chain value analysis – pearl oysters

A summary of the value analysis for the pearl oyster supply chain (Fig. 11) in SE. Sulawesi is provided in Figure 12, and is based on the most common channel that the growers produce and sell their product. The chain shows only two sectors, in which total 'through chain' added value is estimated at about Rp 39,500/pinch, based on an overall 'through chain' cost of about Rp. 10,650/pinch.

Figure 12. The value analysis for pearl oyster supply chain in SE Sulawesi

The highest proportion of the added value (99.%) is received by the trader, but with an estimated share of 97.7 % of the total cost. The relatively high share of added value is due to the exclusive export marketing arrangements, and the high costs are for substantial labor, processing and handling of the oysters and associated pearl products. By comparison, the growers receive only about 1 % of total added value, with about 2.3 % of the total cost for providing site preparation, labor cost and buying the oyster seed from the trader.

Summary

A summary of the mariculture supply chain value analysis from 2008 survey results is provided in Table 6 and Figure 13, showing relative flow of proportional benefits (net through chain value over cost; increasing with ratio > 1.0) for products and associated supply chains for all study areas (pooled). This shows a substantially disproportionate flow of benefits to growers and traders in the grouper sector over other supply chain stages and products, but with an otherwise consistent trend of increasing flow of benefits through the chain, from producers (fishers and growers) to traders, for all products.

Table 6. Summary of supply chain value analysis for the mariculture sector in SE Sulawesi, 2008.

Supply chain order	Supply chain	Product	Through chain value added (% of total)	Through chain cost (% of total)	Proportional flow of benefit (Value:Cost)
1	Fisherman	Abalone	3	11.8	0.25
2	Grower	Abalone	0	0	0.00
3	Village Trader	Abalone	65.7	35.3	1.86
4	Inter Island Trader	Abalone	31.3	52.9	0.59
1	Fisherman	Grouper	15.3	64.6	0.24
2	Grower	Grouper	11.4	1.1	10.36
3	Village Trader	Grouper	27.5	1.5	18.33
4	Inter Island Trader	Grouper	45.8	32.8	1.40
1	Fisherman	Sea Cucumber	1.1	3.8	0.29
2	Grower	Sea Cucumber	1.6	2.6	0.62
3	Village Trader	Sea Cucumber	45.7	44	1.04
4	Inter Island Trader	Sea Cucumber	51.7	49.5	1.04
1	Fisherman	Seaweed	0	0	0.00
2	Grower	Seaweed	70	75.2	0.93
3	Village Trader	Seaweed	10.5	11.1	0.95
4	Inter Island Trader	Seaweed	19.5	13.7	1.42
1	Fisherman	Spiny Lobster	23.4	52.7	0.44
2	Grower	Spiny Lobster	16.19	10.1	1.60
3	Village Trader	Spiny Lobster	6.3	16.9	0.37
4	Inter Island Trader	Spiny Lobster	54.1	20.3	2.67
1	Fisherman	Pearl Oyster	0	0	0.00
2	Grower	Pearl Oyster	1	2.3	0.43
3	Village Trader	Pearl Oyster	0	0	0.00
4	Inter Island Trader	Pearl Oyster	99	97.7	1.01

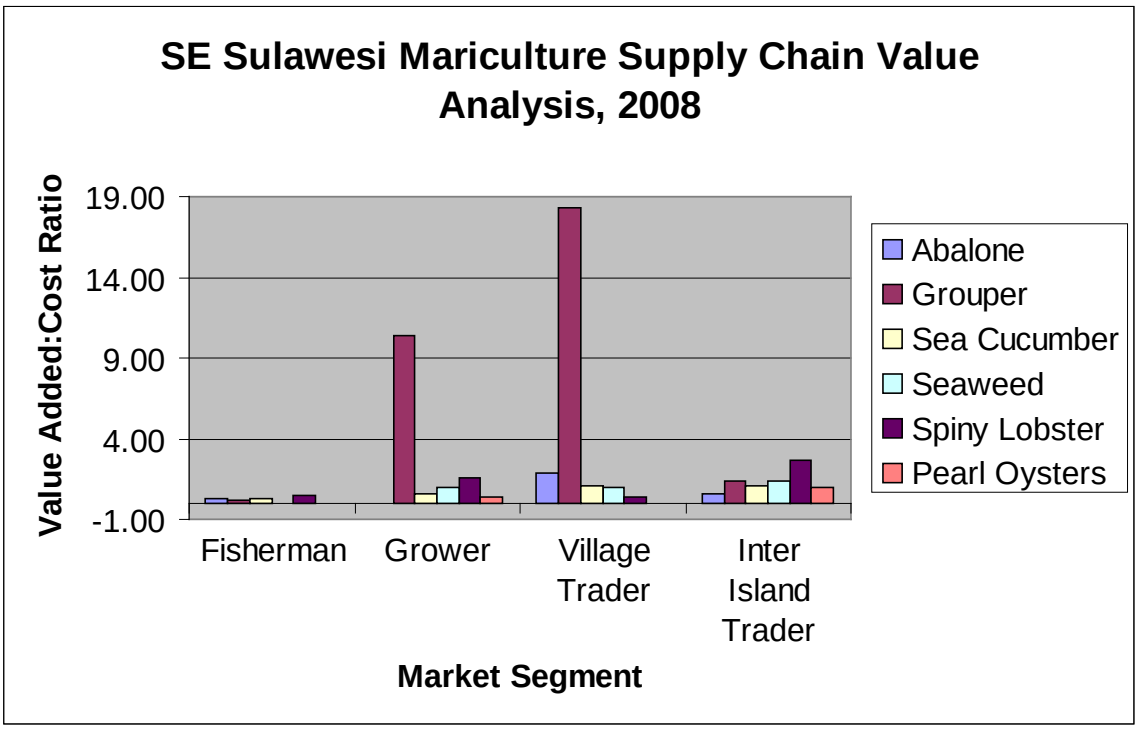

Figure 13. Summary of supply chain value analysis for the mariculture sector in SE Sulawesi, 2008.

5 CONCLUSIONS

The mariculture industry in SE Sulawesi plays an important role in providing existing source of income, jobs and potential employment opportunities for rural, coastal communities, and export earnings for the local economy. SE Sulawesi has expansive areas for potential mariculture development, but also faces various constraints, such as low productivity due to use of traditional technologies, weak bargaining position for local stakeholders in terms of accessing finance and increased share of product value. In Kendari Bay in particular, the mariculture industry faces a potential environment problem due to the expansion of urban and coastal development.

In summary, the SE Sulawesi supply chain characteristics vary considerably across locations and products. Some chains are reasonably well established, relatively short and simple. Other chains are quite complex and long, and only recently established or still emerging. All supply chain stages currently play an important role. Fishers and growers are at the very start of the chain and are therefore critical to all latter stages. Village fish traders play a prominent role to collect the mariculture products in various remote locations. A relatively small number of inter-island traders strictly control the distribution and marketing of products to various local and export destinations, as well as providing financial support through loans to village fish traders. In this context, financial hardsip and constraints on expansion remain a serious problem for village fish traders and by association therefore fishers and growers in all areas and for all products. Access to other, more equitable, 'external' sources of income through governmental/inter-governmental agencies and/or private, joint venture capital investment is required to alleviate this problem for producers and local village collectors

Overall, the flow of benefits in terms of share of through chain value is disproportionate, with fishers and growers typically disadvantaged by comparison to traders. In turn, local village traders typically receive proportionately less of the overall through chain value compared with inter-island traders; the latter having the only direct link into the final consumer market place. More specifically, the fishers and growers have a relatively weak bargaining position in the transaction of mariculture products in the marketplace. This imbalance needs to be addressed, perhaps through introduction of an auction-type market

system and/or negotiation of forward purchase contracts in order to improve the bargaining position of various stakeholders at the production end of the supply chain.

The reliability of existing mariculture production and supply statistics for the industry is relatively low due to inconsistent and incorrect recording and reporting of production and market data, especially for live products. Unreported transhipment occurs in many places because the live fishes are sold for export directly to fishing vessels at sea where production occurs.

Currently, SE Sulawesi is known primarily as one source of 'raw material' for the mariculture industry in Indonesia, with little emphasis on post-harvest added value. Infrastructure at production sites is limited by available technology and finance, which limits potential expansion. Mostly traditional technologies are utilised and available finance through the existing supply chain is typically controlled by the traders. Post-harvest infrastructure at existing landing sites is limited and suitable processing, warehousing and transportation systems are needed to support the development of mariculture in SE. Sulawesi. Capacity building and institutional development at all stages is required and is considered an increasingly important investment priority in order to maintain sustainability and to increase economic viability of the SE Sulawesi mariculture industry.

6 Acknowledgements

The present study was undertaken on a collaborative basis by the Fisheries Faculty, University of Haluoleo (Univ. Halu.), the Indonesian Centre for Marine and Fisheries Socio-Economic Research, the Network of Aquaculture Centres in Asia-Pacific and the Department of Primary Industries (Fisheries Victoria), Australia. The following people made valuable contributions in various ways to the completion of this study:

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Network of Aquaculture Centres in Asia-Pacific:

- Prof. Sena De Silva

Department of Primary Industries (Fisheries Victoria), Australia:

- Mr Geoff Gooley and Mr Lars Olsen

Particular acknowledgement is made of the contribution from the Univ. Halu. students listed above who undertook the majority of the field data collection and initial analysis and summary reporting. The performance of the students in this respect was of a very high standard, including the seminar presentation at an international workshop (Kendari, April 25, 2009) of the survey findings. This presentation was supplemented by high quality English and bahasa translated seminar notes, and was the first ever English speaking presentation by students at such a forum in the > 25 year history of the university. The students are to be complemented on this outstanding achievement.

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Attachment Sample mariculture supply chain (Growers) survey questionnaire in Bahas language.

ASSESSING MARICULTURE MARKET CONSTRAINTS AND POTENTIAL IN SOUTHEAST SULAWESI
Baseline Socio-Economic Survey of Mariculture Market Chain in Selected Areas of SE Sulawesi

ACIAR – HALUOLEO UNIVERSITY - ICMFSER

A1 **KUESIONER PRODUSEN PENANGKAP DARI ALAM**

I. KETERANGAN LOKASI RESPONDEN

Kabupaten / kota	:	
Kecamatan	:	
Desa	:	
Nama Responden	:	
Nomor Responden	:	

II. KETERANGAN TENTANG WAWANCARA

Tanggal wawancara	:	
Nama Pewawancara	:	
Nama Pemeriksa	:	

III. RINGKASAN TENTANG RESPONDEN DAN USAHA

Umur responden	:	
Tingkat Pendidikan	:	
Pekerjaan Utama responden [a]	:	
Jumlah anggota keluarga (AK)	:	
Jumlah AK yang bekerja	:	
Pengalamam Sbg nelayan	:	
Jenis komoditas yang dikumpulkan [b]	:	
Kepemilikan usaha [c]	:	
Bentuk Usaha [d]	:	
Jumlah Tenaga kerja (org)	:	

[a] Pilih Salah satu : grouper, sea cucumber, spiny lobster, abalone, pearl Oyster
[b] Pilih salah satu : milik sendiri, patungan, milik pengusaha lain.
[c] Pilih salah satu : perseorangan, perusahaan.
[d] Pilih Salah satu: A). nelayan penangkap ikan, B). pembudidaya, C). pedagang, D). pegawai pemerintah, E). Lainnya: ..... (sebutkan)

IV. KETERANGAN TENTANG KEGIATAN USAHA RESPONDEN

1. Penguasaan Aset Produktif

Jenis Aset	Jumlah (unit)	Tahun Pembelian	Perkiraan Nilai (000 Rp)		Status[a]
			Pembelian	Sekarang	
Peralatan					
1. Jaring					
2. Pompa air					
3. Tangguk					
4.					
5.					
6.					
Sarana Transportasi					
1. Perahu					
2. Spd motor					
3. Sepeda					
4. Gerobak					
5.....					
6.....					
7.....					

a) Status: Pilih salah satu: A). Milik Sendiri, B). Sewa, C). Pinjam

2. Input – Output Usaha Penangkapan dari alam

2.1. Produksi per Bulan : (Pilih salah satu: grouper / sea cucumber / spiny lobster/ abalone)

Uraian	Keterangan
1. Cara memproduksi	a. Dibudidayakan b. Ditangkap dari perairan [f]
2. Musim produksi :	
a. Bulan Musim Puncak	
b. Bulan musim biasa	
c. Bulan musim paceklik	
3. Kondisi musim saat survey	a. Musim Puncak. b. Musim Biasa c. Musim Paceklik
4. Produksi Kotor (Kg)	
5. Produksi Bersih (Kg)[a]	
6. Sistem Penjualan dominan[e]	
7. Bentuk yang dijual	
a. Utuh / hidup (Kg)	
b. Cangkang (Kg)	
c. Daging (Kg)	
8. Harga (Rp/Kg)	
a. Utuh / hidup (Kg)	
b. Cangkang (Kg)	
c. Daging (Kg)	
d. Nilai Produksi Bersih (Rp)	
e. Pembeli dominan[b]	
f. Cara Pembayaran[c]	
g. Lokasi Penjualan[d]	
h. Biaya Transportasi ketempat penjualan (Rp/Kg)	

[a] Produksi Bersih: Produksi Kotor – Bagi Hasil
[b] Isikan: A). Pedagang Pengumpul desa. B). Pedagang Besar. C). Restoran
[c] Cara Pembayaran : A. Tunai. B. Dicicil. C. Dipinjamkan D. Lainnya: .....
[d] Lokasi Penjualan : A. Di tempat Budidaya. B. Di Gudang. C. Diantar Ketempat Pedagang.
[e] Sistem Penjualan: A). Dijual Langsung, B.) Dijual Bertahap
[f] Lanjutkan ke pertanyaan 2.2.

2.2. Biaya Penangkapan dari alam per trip

a. Lama Satu Trip penangkapan : ..... Jam

b. Jumlah Trip per bulan: .....

c. Sebutkan bulan penangkapan: .....

Jenis Biaya	Keterangan			
	Satuan	Jumlah	Harga per satuan (Rp)	Total Nilai (Rp)
Biaya Operasional				
1. Solar	Liter			
2. Bensin	Liter			
3. Minyak Tanah	liter			
4. Oli	liter			
5. umpan	kg			
6. Bahan makanan	paket			
Upah				
1. Jumlah Tenaga Kerja	Org		X	X
- Dalam Keluarga	Org		X	X
- Luar Keluarga	Org		X	X
2. Upah Tenaga Kerja Luar Keluarga	HOK			
Pungutan				
1. Retribusi	trip			
2. Uang keamanan	trip			

2.3. Pengeluaran Lain

Uraian	Satuan	Jumlah	(Rp/Satuan)	Total Nilai (Rp)
1. PBB	Tahun			
2. Iuran Pembangunan Desa	Tahun			
3. Iuran Kelompok	Bulan			
4. Iuran Keamanan	Bulan			
5. Sewa lahan	Bulan			
6. Sewa Lokasi Budidaya	Bulan			
7.....				
8.....				

2.4. Sumber Modal

Sumber Modal	Jumlah (Rp)	Bunga (%/thn)	Lama Cicilan (Bln)	Total Pengembalian (Rp)
1. Bank				
2. Pegadaian				
3. Koperasi				
4. Kredit Program				
5. Kios Saprokan				
6. Rentenir				
7. Pedagang Pengumpul desa				
8. Pedagang Besar				
9. Saudara				

2.5. Penjualan Hasil (Volume dan Harga per satuan)

Jenis Produksi	Pembeli	Besar Pembelian		Harga (Rp/Satuan)	Jarak ketempat Pembeli (km)
		Jumlah	Satuan		
Hidup	Pedagang desa		Ekor		
	Ped. Besar		Ekor		
	Pembudidaya		Ekor		
	Pedagang Antar Pulau		Ekor		
	Restoran		Ekor		
Setelah penanganan	Pedagang desa		Kg		
	Ped. Besar		Kg		
	Pembudidaya		Kg		
	Pedagang Antar Pulau		Kg		
	Restoran		Kg		
Bentuk lain	Pedagang desa		Kg		
	Ped. Besar		Kg		
	Pembudidaya		Kg		
	Pedagang Antar Pulau		Kg		
	Restoran		Kg		

5

2.6.Perkembangan harga komoditas marikulture selama 1 Minggu terakhir .

Hari	Grouper[x]	Sea Cucumber	Abalone	Spiny Lobster [y]	Pearl Oyster
	(Rp/ekor)	(Rp/Kg)	(Rp/Kg)	(Rp/ekor)	(Rp/butir)
Jenis					
Hari 1					
Hari 2					
Hari 3					
Hari 4					
Hari 5					
Hari 6					
Hari 7					

Hari ke 7 adalah hari wawancara.

Keterangan: [x]. Pilih Salah satu: A). Kerapu Macan, B.) Kerapu Tikus, C). Lainnya: .....

[y]. Pilih Salah satu: A). Mutiara, B). Bambu, C). Batik, D). Lainnya: .....

3. Gambarkan Rantai Pemasaran komoditas perikanan yang yang dihasilkan

Report

"Seafood Market Supply Chain – South East Sulawesi"

for

Fisheries and Aquaculture
Department of Primary Industries Victoria

Prepared by:

Phillip Morey
Morelink Asia Pacific

18th June 2008

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FIGURES

APPENDICES

EXECUTIVE SUMMARY

Seafood is a major part of Indonesian exports and represented 15% (US$1.6 billion) of agrifood exports in 2006. Indonesia exports a wide range of seafood to a wide range of markets. Overall, Asian countries buy most of the volume and value of Indonesia's seafood exports at 70% and 46% respectively.

Exports of crustaceans were valued at US$1,120.8 million in 2006, mainly shrimp. The main export markets were Japan (38%), USA (36%), EU (15%) and HK/China (5%).

Exports of fresh seafood were valued at US$456.1 million in 2006, mainly tuna. The main export markets were Japan (25%), USA (19%), Singapore (11%) and HK/China (10%). Live lobsters (US$6 million) and other live fish are mainly exported to Hong Kong.

Exports of dried seafood were valued at US$61.6 million in 2006. The main export markets were Japan (69%), HK (10%) and Singapore (7%). Dried Abalone (US$3.7 million) is mainly sent to North America (83%), whereas dried sea cucumber (US$4.9 million) goes mainly to HK (41%) and dried seaweed (US$24.8 million) is exported to a multitude of markets in Asia, Europe and South America.

The two major cities and ports of Indonesia (Jakarta and Surabaya) are the main exporters of seafood, although most of this has been sourced from other provinces, including Sulawesi.

South East Sulawesi, with a population of only 2.1 million people, is a major source of agriculture and fishery products. The volumes of seaweed, sea cucumber and lobsters have all increased in sales over the last year. These products are sold mainly to local traders who sell to buyers in the major cities of Makasssar, Surabaya or Jakarta for export or local consumption. Kendari is not an export port but is a source of seafood for export.

The supply and market chain for live fish is as follows:

- Fishermen catch live fish and sell to other fishermen who own a karumba
- Collector boats pick up fish from karumbas and sell to packers or traders
- Packers are owned by traders or businessmen
- Traders take the fish from packers and send to exporters or bigger traders for Hong Kong

The major problem and challenge facing fishermen and other supply chain participants is to reduce the mortality of live fish.

The supply and market chain for live lobster is as follows:

- The live lobsters are placed in holding tanks at the packing shed for about 24 hours;
- The lobsters are packed in 20 kg polystyrene cartons and are individually wrapped in newspaper;
- Lobsters are sent by airfreight to Surabaya or other major cities;
- The cartons are unpacked in Surabaya and the lobsters are placed in holding tanks to maintain their freshness;

- The lobsters are exported from Surabaya by airfreight to HK or sold to buyers in major cities in Indonesia.

The supply and market chain for processed abalone and sea cucumber is as follows:

- Fishermen catch abalone and sea cucumber and undertake some drying
- Sell to processors and traders
- Traders will undertake further processing and drying
- Product is sold to traders for export

The challenges are: (1) to obtain a continuous supply of good quality abalone, and (2) drying abalone during the wet season. The quality varies due to poor practices by the fishermen; they keep the abalone too long before boiling or salt then boil (reverse order) which impacts on quality.

The supply and market chain for seaweed is as follows:

- Fishermen harvest seaweed and undertake some drying
- Sell to traders
- Traders will undertake further processing and drying
- Product is sold to traders for export

The problem with quality is due to poor cultivation techniques and poor selection of location. Also, seaweed needs 4-5 days to dry but many farmers sell after 2 days of drying. There is no direct export of seaweed from Kendari as: Not enough supply; No established relationship with importers; Facility not suitable for export; difficult to access shipping containers; Chinese traders in Makassar (and other ports) control the export.

South Sulawesi with a population of 8.5 million is considered as a centre for trading. The Makassar port has sea trade responsibility for eastern Indonesia and has a modern port with refrigeration facilities. In Makassar there are 26 different species of seafood exported by 118 registered exporters; seaweed being the most popular.

The central cooperative buys seafood from 18 primary cooperatives located in the districts of South Sulawesi. Each primary cooperative has about 1,500 fishermen.

The central cooperative handles a range of seafood with most sales being frozen fish (35%), seaweed (45%) and sea cucumber (20%). The central cooperative will sort the various seafood products and packs for export or inter island trade. Primary cooperatives do some sorting. Problem is that the primary cooperatives do not have access to air blasters to reduce quickly temperatures of the product; this can result in deterioration.

To increase revenues for the fishermen of SE Sulawesi there is a need to reduce the mortality of live fish through education of improved husbandry practices and separating the unhealthy fish. There is an opportunity to introduce packing facilities in fishing communities so that they can hold and pack fish for the market. This will bring the fishermen closer to the market and improve market signals which could lead to an increase in profit per kg of seafood.

1. INTRODUCTION

1.1 Background

The Australian Centre for International Agricultural Research (ACIAR) has provided funding to Fisheries and Aquaculture of the Department of Primary Industries Victoria for a scoping study on South East Sulawesi seafood industry entitled: *"Assessing Mariculture Market Constraints and Potential in SE Sulawesi – Stage 1: Stakeholder Engagement & Situation Analysis (#SMAR/2007/225)"*. This project is being managed by Geoff Gooley, Project Manager, Fisheries and Aquaculture of the Department of Primary Industries Victoria.

Geoff Gooley has asked Phillip Morey of Morelink Asia Pacific to undertake a study on Seafood/Mariculture Market Chain Mapping & Analysis for SE Sulawesi, Indonesia. Phillip Morey has a consultancy business in Indonesia to help Australian companies in doing business in Indonesia with a focus on the agrifood sector.

1.2 Objectives

The primary objectives of this consultancy were to:

- map the mariculture[1] market chain for SE Sulawesi (emphasis on key post-production components), and characterise supply/demand dynamics, logistics and key chain components/contacts, and to
- collate and analyse key market chain data, including tonnage and value, for determination of major opportunities and constraints for SE Sulawesi.

The context for the consultancy was further defined as follows:

- Market chain components to focus on starting with major traders in Kendari and Bau Bau, through to major buyers in key domestic (Indonesia) and export (Asia-Pacific) markets;
- Key mariculture products of interest to include:
    - Kendari - Marine grouper and spiny lobster (live trade), abalone (processed), sea cucumber (processed/dried) and seaweed (raw/dried), and
    - Bau Bau – as for Kendari but also including pearl oyster.

Specific tasks included:

- Describe and where appropriate quantify the logistics, infrastructure and supply/demand dynamics for mariculture trade:
    - within/between Kendari, Bau Bau and other major domestic ports/market destinations in Indonesia (including Makassar and Surabayia) and
    - key Asian export ports/market destinations (including Singapore, Hong Kong, Shanghai, Taiwan and Australia where appropriate).
- Obtain information on the scale/scope of existing seafood trade along these routes, with emphasis on key species/products of interest;
- Identify potential for tapping into new markets/addressing latent shortfall in demand;
- Identify constraints to accessing new markets and/or limiting access to existing markets;

[1] The word "seafood" is used throughout the report for "mariculture".

- Provide a list of potential key industry contacts (current/potential operators and/or investors) to facilitate the development of the mariculture market chain in SE Sulawesi, with emphasis on post-harvest end of the chain (ie. traders, processors/value adding, freight providers etc).

1.3 Approach

There were three stages for this project.

1. Review data, obtain export statistics and market analysis – desk research (mid April)
2. Market Chain research – conducted in-market visit to South East Sulawesi (Kendari) and South Sulawesi (Makassar) for interviews and local export statistics (1^{st} – 6^{th} May)
3. Analysis and final report preparation (mid May).

Phillip visited South East Sulawesi with Mr Andrew Winstanley, an Australian businessman based in Jakarta, with many years experience as an owner operator of an aquaculture business in Kendari. Mr Luthfi Fatah, Research Management Adviser ACIAR – SADI, joined the team in Kendari and accompanied Phillip to meetings with Dr Aslan (Dean) and Mr Haris Sarita (Lecturer) from the Fisheries Faculty, University Haluoleo and some traders. Mr Haris assisted by organizing some appointments with traders in Kendari and accompanied Phillip to some of the meetings.

It was planned to visit Bau Bau while in Kendari however it was suggested (given time constraints) that it would be better to allocate more time with traders across a range of mariculture species in Kendari and buyers in Makassar. (A list of traders operating in Bau Bau is provided in Appendix 3.3)

1.4 Report

A "meeting notes report" has been prepared as a record of interviews; this has been forwarded to the Project Leader, Geoff Gooley.

In this report an analysis of Indonesian trade statistics (BPS) on export market size, location source and export markets for mariculture products is presented in Section Two.

Section Three provides an overview of South East Sulawesi and the supply market chain for the key seafood species.

Section Four provides information on South Sulawesi as the main port in Eastern Indonesia for the trade of seafood.

A summary of the key issues and conclusions from the research are presented in Section Five.

A copy of the itinerary, questionnaire and contacts are provided in Appendix One, Two and Three respectively. Detailed Indonesian and South East Sulawesi export statistics of the targeted seafood species are provided in Appendix Four and Five respectively.

2. INDONESIAN SEAFOOD EXPORTS

Indonesia, with a population of 220 million people (2005), comprises 17,000 islands and as such is a major producer and consumer of seafood. Indonesian people consume on average 18.75 kg per annum (2003) of fish compared to 0.95 kg per annum of red meat. Fish is seen as a cheap source of protein for most Indonesians.

Since Indonesia is a major producer of fish, fish imports are relatively minor with only 25 tons imported in 2005 with Australia supplying about 2% of fish imports. (However, these imports figures appear to be understated.)

2.1 Overview

In 2006, Indonesia exported over US$11 billion of agrifood products with seafood products representing 15% of exports (US$1,640 million); the second largest category after "oils" (which accounted for 55% of agrifood exports).

The export volume of seafood has increased by 5% in the last year to over 700,000 tonnes in 2006.

An analysis of tables 1 - 2 below show that fresh fish exports dominate the volume of seafood exports with 62% (478,000 tonnes) while crustaceans dominate the value of seafood exports with 57% (US$1,120 million).

2.2 Export Markets

Indonesia exports seafood to a wide range of markets depending on the species. Overall, Asian countries buy most of the volume of Indonesia's seafood exports at 70% but only 46% of the value. While USA and EU countries bought 21% of the volume and 47% of the value of Indonesian seafood exports in 2006. (See tables 1 and 2 below.)

Exports of crustaceans were worth US$1,120.8 million in 2006 with the main markets being Japan, USA and EU. Indonesian exports of crustaceans by value are mainly sent to non Asian countries which accounted for 54% of the value of exports in 2006 with USA at 36% and EU at 15%. Exports to Asian countries are mainly sent to Japan (38%) and HK/China (5%).

In 2006, Indonesia exported 169,581 tons of shrimp worth about $1 billion, an increase from 153,906 tons in 2005. Indonesia is now the largest shrimp exporter to Japan and the second largest to the USA. The target of Indonesia's shrimp production set by the government is at 410,000 tons until the end of 2007, which maybe difficult to meet as shrimp breeding has not been at optimal levels. [2]

Exports of fresh seafood were worth US$456.1 million in 2006 with the main markets being Japan, USA and Singapore. Exports by value to Asian countries are mainly sent to Japan (25%), Singapore (11%), HK/China (10%) and Thailand (8%) whereas other non Asian countries account for 35% of the value of exports with USA at 19%.

[2] CIC Monthly Reports

Indonesia's tuna production increased to 125,325 tons in 2006 and was projected to increase by at least 5 percent in 2007. About 30% of the tuna imported by Japan, which consumes about 70% of the world's total tuna production, comes from Indonesia.[3]

Table 1: Indonesia Fish Exports by Market 2006, Volume (Tonnes)

Country	Fresh (034)	Dried (035)	Crustaceans (036)	Other (037)	Total	%
Australia	2,826	158	1,933	73	4,990	0.6
China	55,159	1,335	11,389	25	67,907	8.8
HK	13,099	836	9,344	176	23,454	3.0
Japan	39,735	11,460	51,775	10,301	113,272	14.6
Malaysia	26,599	2,406	6,218	1,212	36,435	4.7
Singapore	38,662	2,473	7,886	94	49,115	6.3
Taiwan	21,571	511	2,577	77	24,736	3.2
Thailand	212,858	163	7,573	4,068	224,662	29.0
USA	23,557	65	55,621	34,810	114,053	14.7
European Union *)	10,439	77	29,297	11,504	51,317	6.6
Other	33,360	5,638	11,173	15,730	65,901	8.5
TOTAL	**477,865**	**25,122**	**194,785**	**78,070**	**775,842**	**100.0**

*Note: *) UK, Nederland, Germany, Belgium, Italy and France*
Source: The Indonesian Bureau of Statistics (BPS)

Table 2: Indonesia Fish Exports by Market 2006, Value (US$ 1,000)

Country	Fresh (034)	Dried (035)	Crustaceans (036)	Other (037)	Total	%
Australia	6,345	271	9,031	1,911	17,558	0.9
China	20,084	1,285	18,994	376	40,739	2.1
HK	27,845	6,182	32,709	848	67,585	3.5
Japan	113,905	42,339	422,411	38,695	617,350	31.6
Malaysia	21,053	564	8,284	1,761	31,663	1.6
Singapore	49,287	4,524	12,371	257	66,438	3.4
Taiwan	18,467	648	4,546	176	23,837	1.2
Thailand	35,954	372	5,382	69	41,777	2.1
USA	87,772	180	402,899	190,513	681,364	34.8
European Union *)	27,564	98	163,219	41,887	232,768	11.9
Other	47,844	5,153	40,999	40,378	134,374	6.9
TOTAL	**456,120**	**61,616**	**1,120,845**	**316,871**	**1,955,453**	**100.0**

*Note: *) UK, Nederland, Germany, Belgium, Italy and France*
Source: The Indonesian Bureau of Statistics (BPS)

Exports of dried seafood were worth US$61.6 million in 2006. Exports of dried seafood by value to Asian countries are mainly sent to Japan (69%), HK (10%) and Singapore (7%) whereas other non Asian countries account for only 8% of the value of exports.

[3] CIC Monthly Reports

The total production of seaweed in 2005 reached 910,636 tons and was expected to climb to 1 million tons in 2006. Indonesia is the second largest seaweed exporter in the world after the Philippines.[4]

Appendix Four provides detailed export statistics by country for the targeted seafood species – dried abalone, live lobsters, dried sea cucumber, oysters and seaweed. A summary of the export data for 2006 is provided below and in Table 3.

- Dried Abalone – US$3.7 million with the main markets being USA (54%) and Canada (29%).
- Live Lobsters (not including rock lobsters) – US$6.0 million with the main markets being HK (92%).
- Dried sea cucumber – US$4.9 million with the main markets being HK (41%), Vietnam (13%) and Singapore (12%).
- Seaweed – US$24.8 million with the main markets being China (23%), HK (14%) and Philippines (12%).

Table 3: Indonesian Selected Seafood Exports by Value and Volume, 2006

HS	Commodity	Weight (kg)	Value (US$)
1605901000	Abalone, Prepared or Preserved	1,395,307	3,691,565
0306212000	Rock Lobsters and Other Sea Crawfish, Live	417,602	1,811,718
030621300	Rock Lobsters and Other Sea Crawfish, Fresh or Chilled	469,294	749,520
0306222000	Lobsters, Live	1,140,374	6,049,254
0306223000	Lobsters, Fresh or Chilled	21,563	60,670
0307101000	Oysters, Live	59,524	83,085
0307102000	Oysters, Fresh, Chilled or Frozen	108,078	179,044
0307103000	Oysters, Dried, Salted or in Brine	37,569	73,078
0307992000	Beche-De-Mer (Sea cucumber / Trepang), Dried, Salted or in Brine	1,748,218	4,946,060
1212201000	Seaweeds & Oth Algae Fresh, Chilled or Dried	58,525,446	24,708,811
1212202000	Seaweeds & Oth Algae, Fresh, Chilled or Dried; Not for Human consumption	8,347,233	4,011,800

Source: The Indonesian Bureau of Statistic (BPS Book, 2006)

2.3 Provinces

The two major cities and ports of Indonesia (Jakarta near West Java and Surabaya in East Java) are the main provinces that export seafood accounting together for 38% and 57% of the volume and value of Indonesia's seafood exports respectively. Most of this has been transshipped from other provinces due to better logistics and shipping frequencies from Jakarta and Surabaya.

Jakarta, the capital of Indonesia, is a small province on the northwest coast of the island of Java. Jakarta has a population of 8.7 million people in 2005 (ranked 6th in population size in

[4] CIC Monthly Reports

Indonesia). Jakarta has the largest economy in Indonesia with a GDP of Rp. 436 trillion and a GDP per capita of Rp. 50 million (2nd largest). Jakarta is the "gateway" to business in Indonesia and has the largest port. It is the major link to the provinces in western Indonesia (Sumatra).

Surabaya, the capital of East Java, is located on the eastern part of the island of Java. East Java covers an area of 48,000 km² with a population of 35.6 million in 2005 (2nd largest in Indonesia). East Java has the 2nd highest GDP in Indonesia of Rp. 403 trillion and a GDP per capita of Rp. 11.3 million (ranking it 5th). East Java is a major industrial region and a trading hub linking with provinces in Eastern Indonesia.

South Sulawesi (port of Makassar) is the third largest exporter of seafood (in terms of value), mainly with fresh fish and crustaceans.

Table 4 : Indonesia Fish Exports by Province 2006, Volume (Tonnes)

Province	Fresh (034)	Dried (035)	Crustaceans (036)	Other (037)	Total	%
North Sulawesi	21,785	1,103	75	6,656	29,619	3.8
S.E Sulawesi	402	-	-	-	402	0.1
South Sulawesi	6,709	313	8,397	26	15,444	2.0
Bali	13,374	7	892	3	14,277	1.8
East Java	75,621	13,782	59,599	51,182	200,184	25.8
Jakarta	56,959	5,224	26,433	8,457	97,072	12.5
Other	303,015	4,693	99,390	11,746	418,844	54.0
TOTAL	**477,865**	**25,122**	**194,785**	**78,070**	**775,842**	**100.0**

Source: The Indonesian Bureau of Statistics (BPS) Catalogue 8102

Table 5 : Indonesia Fish Exports by Province 2006, Value (US$ 1,000)

Province	Fresh (034)	Dried (035)	Crustaceans (036)	Other (037)	Total	%
North Sulawesi	12,473	4,344	517	13,178	30,512	1.6
S.E Sulawesi	578	-	-	-	578	0.0
South Sulawesi	31,442	1,122	59,361	336	92,261	4.7
Bali	52,893	90	2,967	25	55,974	2.9
East Java	93,791	42,248	416,719	218,409	771,167	39.4
Jakarta	151,872	9,995	142,335	31,502	335,703	17.2
Other	113,072	3,818	498,947	53,422	669,258	34.2
TOTAL	**456,120**	**61,616**	**1,120,845**	**316,871**	**1,955,453**	**100.0**

Source: The Indonesian Bureau of Statistics (BPS) Catalogue 8102

3. SOUTH EAST SULAWESI

3.1 Population

South East Sulawesi is one of the most remote regions of Sulawesi with no highway connecting it to the other provinces on the island of Sulawesi. The main transportation link is a ferry across the Bone Sea between Watampone (Bone) in South Sulawesi and the port of Kolaka in South East Sulawesi. The population of the province is 2.1 million people, mostly centered on Buton island, off the south coast of South East Sulawesi and in and around Kendari (the capital).

3.2 Economy and Transport

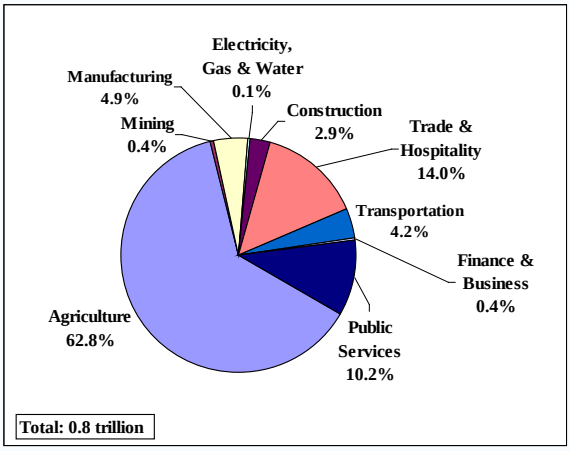
Agriculture[5] activity dominates the economy of South East Sulawesi producing 40% of its GDP and employing 64% of the workforce. The other important industry sector is trade and hospitality with 14% of GDP and employment.

The main container shipping line servicing South East Sulawesi is Meratus Line. There is no cold storage or refrigerated containers at the main cargo port in Kendari. The ships go via Raha then to Bau Bau – which is a main transit port to Eastern Indonesia (Ambon, Papua). Bau Bau is a deep sea port and is also one of the main distribution channels to send seafood to Surabaya.

Figure 1a. SE Sulawesi Economic Activity

Source: BPS (Catalogue No. 9203)

Figure 1b. SE Sulawesi Employment by Sector



Source: BPS (Catalogue No. 2117.35)

[5] Includes fisheries

3.3 Seafood Supply and Market Chain Linkages - Overview

There are three options to send seafood to the main ports on the island of Java from South East Sulawesi (1) by truck overland to Makassar (capital of South Sulawesi) then by ship/air, (2) by ship from Buta Buta port or (3) by air from Kendari airport.

All seafood that is sent for export must be inspected by Quarantine, if required by the importing country. There are 461 fish traders in Kendari on the registry with Quarantine; however many of these are individuals and have only exported small amounts in the past.

Seaweed, sea cucumber and lobsters are sold mainly to local traders who sell to buyers in the major cities of Makasssar, Surabaya or Jakarta for export or local consumption. Kendari is not considered as an export port but is a source of seafood for export.

3.4 Live Fish Supply and Market Chain

Many fishermen bring their live fish catch back to their village and store in a karumba (fish holding tank in the sea water). The fish may be kept for up to 2 months to improve their growth or their health and to build up stock. Collectors in boats will buy live fish from the karumba to sell to traders.

The supply market chain is as follows:

- Fishermen catch live fish and sell to other fishermen who own a karumba
- Collector boats pick up fish from karumbas and sell to packers or traders
- Packers are owned by traders or businessmen
- Traders take the fish from packers and send to exporters or bigger traders

The major problem and challenge facing fishermen and other supply chain participants is to reduce the mortality of live fish.

There are only two main traders in Kendari of live fish for export by air.

<u>Case Study - Mr Ramland (packer and trader of live fish)</u>

Mr Ramland is the manager of a packing/trading business in Kendari which is owned by a Chinese Indonesian man from Jakarta (Mr Paulus from PT Perlin). Mr Paulus also owns four of the fishing boats which supply the live fish to the packing complex at Kendari.

The marketing chain for live fish from Kendari to HK is as follows:

- late afternoon (5pm) fish arrive by boat at the packing shed in Kendari;
- unloaded and placed into holding tanks to refreshen;
- start packing into boxes at 2am;
- by 4am the boxes of live fish are sent to the airport; Lion Air departs at 6.30am; arrives in Jakarta at 9.00am;
- fish are collected and unpacked into holding tanks in Jakarta (near airport) to refreshen;
- quality checks and repacked in early morning;
- sent to HK on morning flight.

During the high season (September) Mr Ramland will sell 5-7 tonnes per month of live fish to Jakarta for export to Hong Kong via airplane. He sends about 200 kg of live fish per air shipment. The live fish are packed in plastic bags inside polystyrene boxes.

The HK market prefers fish with a red colour and the preferred size is for one portion / plate size (0.5 – 0.7 kg each). The trader's fob[6] airfreight selling price to HK is about Rp1.5 million per kg. The main fish species include: Sunu, Kepapa tika, Saixing, Cappay and Kerac.

The live fish business has many challenges as follows:

- supply is inconsistent
- up to 70% of fish received at the packing shed may not be suitable to export. The fishermen do not know how to keep the fish fresh, alive and in a healthy condition.
- 10% of fish sent to Jakarta are not suitable (dead) to export to HK

Distribution costs for live fish from Kendari to Jakarta are as follows:

- Airfreight – Rp12,000 per kg
- Quarantine – Rp50,000 per inspection
- Local transport – Rp300 per kg
- Airport charges – Rp1,700 per kg

The cheaper and larger sized live fish species are sold to HK boat traders that visit many ports in Sulawesi and Kalimantan over a one month journey. These fish species are mainly black in colour and the Kendari selling price to the HK traders is from Rp75,000 per kg. The main fish species include Kergan Tiger and Kergan Lumpan (up to 5kg).

<u>Case Study – Mr Bobby (trader of live fish / consultant)</u>
Mr Bobby trades in live fish and coordinates live fish exports for some of the boat traders from HK. Every month (on average) there are about eight boats (9 – 20 tons of live fish capacity) that come to Indonesia from HK to buy live fish. This equates to about 1,000 tonnes per year with each HK boat carrying about US$250,000 of live fish (10 tonnes).

The challenge for Bobby is to find enough live fish to meet the capacity of the boat. Hence he will buy live fish from many Indonesian ports and provinces including Sulawesi, Lampung and Kalimantan. HK buyers prefer to buy wild caught fish (garoupa) and will discount by 15% - 20% for similar farmed fish species. About 5% to 15% of live fish may die on the voyage back to HK.

One of the challenges for the fishing industry is to change some of the fishing practices. For example, some Indonesian fishermen may use poison to stun the live fish. This does result in a high level of unhealthy and dead fish and can lead to 50% of coral trout dying and up to 30% of tiger garoupa dying, according to Bobby.

[6] FOB is "free on board" - Price quoted at the port of shipment

3.5 Live Lobster Supply and Market Chain

Case Study – Mr Edi (packer/trader of live lobster)
Mr Edi is a partner in a live lobster export business with head office in Surabaya, East Java

The marketing chain for live lobster from Kendari to Asian markets is as follows:

- The live lobsters are placed in holding tanks at the packing shed for about 24 hours;
- The lobsters are packed in 20 kg polystyrene cartons and are individually wrapped in newspaper;
- Lobsters are sent by airfreight to Surabaya;
- The cartons are unpacked in Surabaya and the lobsters are placed in holding tanks to maintain their freshness;
- The lobsters are exported from Surabaya by airfreight to HK or sold to buyers in major cities in Indonesia.

Mr Edi supplies about 5 tonnes per month to Surabaya. Dead lobsters are sold at a discount of 50% of the price. While the local price is about Rp30,000 per kg higher than export it takes longer (by 2 weeks) to receive payment. The price for lobster varies depending on species and size.

Table 6: Lobster Selling Prices, 2nd May 2008

No	Lobster Species	Size (grams)	Price (Rp) / kg
1	MUTIARA	2400 UP	300,000
		2000 / 2400	315,000
		1000 / 2000	395,000
		600 / 1000	340,000
		300 / 600	275,000
		200 / 300	270,000
		100 / 200	295,000
		60 / 100	150,000
2	WARNA	500 UP	240,000
		300 / 500	200,000
		200 / 300	190,000
		100 / 200	225,000
		60 / 100	150,000
3	PASIR	500 UP	290,000
		300 / 500	290,000
		200 / 300	290,000
		100 / 200	340,000
		60 / 100	200,000
4	BATU	1500 UP	150,000
		500 / 1500	200,000
		300 / 500	190,000
		200 / 300	190,000
		100 / 200	225,000

		60 / 100	150,000
5	PAKISTAN	500 UP	240,000
		300 / 500	200,000
		200 / 300	235,000
		100 / 200	300,000
		60 / 100	150,000
6	KIPAS MERAH	200 UP	260,000
7	KIPAS MERAH T.	200 UP	160,000
8	KIPAS HITAM	200 UP	150,000

Source: Mr Edi - trader

3.6 Processed Abalone and Sea Cucumber Supply and Market Chain

There are many small processors and traders of dried abalone and sea cucumber operating on the bay of Kendari. They mainly sell to other larger traders or small shops in Kendari and Makassar.

Fresh abalone is bought form local fishermen. The buying price for fresh abalone is Rp50,000 per kg and after drying it is sold for Rp300,000 per kg. The volume of sales depends on the season from 10 kg per month during the wet season and up to 30 kg per day during the dry (peak) season (May to September).

Sea cucumber is bought from local fishermen at a price of Rp5,000 per large piece (30cm); about 500grams. The selling price after drying is Rp500,000 per kg. There is a large weight (water) loss of 85% reduction; 500grams of fresh = 75 grams of dry product.

Case Study – Mr Welly (abalone processor / trader)

Mr Welly buys most of his wet abalone from Central Sulawesi and some from SE Sulawesi. He buys wet abalone from collector where the product has already been boiled and salted. He gives an advance of money to the collector who manages the 10-15 fishermen that supply him; the collector provides money or equipment to the fishermen as a down payment.

He sends the dried abalone to Makassar in second hand boxes by bus or airplane for export.

The challenges are: (1) to obtain a continuous supply of good quality abalone, and (2) drying abalone during the wet season. The quality varies due to poor practices by the fishermen; they keep the abalone too long before boiling or salt then boil (reverse order) which impacts on quality.

The buying price varies based on size and quality; inferior quality is discounted by up to 50%.

Buying prices paid to collectors for "wet"[7] abalone are as follows:

- A class: 25-30 pieces per kg = Rp205,000 per kg
- B class: 30-60 pieces per kg = Rp160,000 per kg
- C class: 60-90 pieces per kg = Rp150,000 per kg
- D class: > 90 pieces per kg = Rp120,000 per kg

[7] 1 kg of wet abalone equates to about 500 grams of dried abalone.

The selling prices received for dried abalone are as follows:

- A class: Rp590,000 per kg
- B class: Rp500,000 per kg
- C class: Rp430,000 per kg
- D class: Rp370,000 per kg

3.7 Seaweed Supply and Market Chain

There are many seaweed suppliers operating in SE Sulawesi.

Case Study – Mr Hasan (seaweed processor / trader)

Mr Hasan is a medium size trader and sells about 1,000 to 2,000 tonnes per year. He gives an advance of money to the collector (or head of farmer group) who manages the supply; the collector provides money or equipment to the fishermen.

The seaweed quality target is based on 38% moisture content on arrival. The price paid to farmers is discounted by up to 30% if the water content of the seaweed is too high.

The seaweed is packed into 60 – 80 kg sacks and sent to Surabaya or Makassar. In Surabaya the sacks are opened and inspected for quality (moisture content) and repacked for export.

There is no direct export of seaweed from Kendari as:

- Not enough supply
- No established relationship with importers
- Facility not suitable for export; difficult to access shipping containers
- Chinese traders in Makassar (and other ports) control the export

The problem with quality is due to poor cultivation techniques and poor selection of location. Also, seaweed needs 4-5 days to dry but many farmers sell after 2 days of drying.

The buying price varies from Rp5,000 per kg (August) to Rp8,000 per kg (May). The selling price is about Rp9,500 per kg. Mr Hasan will sell some seaweed by contract to Makassar, depending on price movements.

4. SOUTH SULAWESI

4.1 Population

The population of the province is 8.5 million people. This is the seventh largest (in terms of population) province in Indonesia and the largest outside of the islands of Java and Sumatra. South Sulawesi has a land area of 62,482 km² and the provincial capital is Makassar.

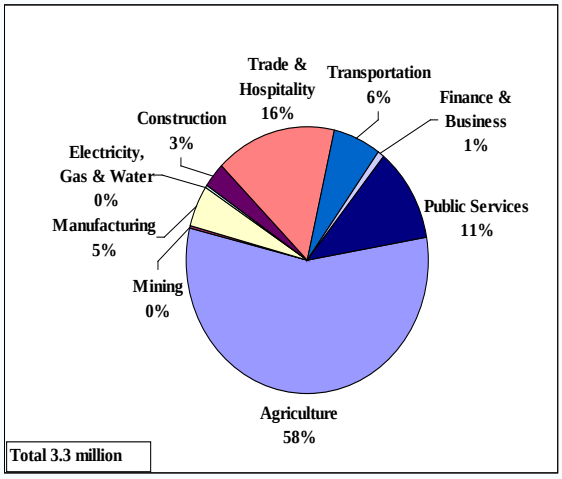
4.2 Economy

Agriculture[8] is the most important industry for the economy of South Sulawesi with 31% of its GDP and employing 58% of the workforce. The other important industry sectors (in contribution to GDP) are trade and hospitality and manufacturing with 18% and 14% respectively.

Makassar is considered as a centre for trading and hence many of the major businesses now based in South Sulawesi were originally traders. Makassar has a modern port with refrigeration facilities.

Figure 2a. S. Sulawesi Economic Activity

Figure 2b. S. Sulawesi Employment by Sector



Source : BPS (Catalogue No. 9203)

Source : BPS (Catalogue No. 2117.35)

[8] Includes fisheries

4.3 Makassar Port and Seafood Exports

Makassar is one of four port authorities in Indonesia under the control of the Central Government (Medan, Jakarta, Surabaya and Makassar). Makassar port has sea trade responsibility for eastern Indonesia (from eastern Kalimantan) and covers 18 sea ports.

In 2006, the Makassar Port handled 12,283 twenty foot containers for export, up from 7,671 containers in 2002. Seafood is number six in volume of export traded through Makassar Port after clinker, cocoa, marble, cement and wood/plywood. Seafood is also ranked sixth in domestic trade after cement, rice, clinker, wheat flour and wood.

Seafood products are exported from Makassar Port to a wide range of markets as follows:

- USA – seaweed and sea products
- Netherland – fish and seaweed
- Belgium – shrimp and seaweed
- France, Germany, Italy, Spain and England – seaweed
- Singapore and Hong Kong – seaweed and sea product
- China – seaweed, shrimp and fish
- Japan – seaweed and sea product
- Australia - shrimp

In 2007 there wee 281 registered exporters with the Makassar Port; 118 (42%) were involved in seafood exports as per the table below.

Table 7: Number of Seafood Exporters from Makassar Port by Fish Type

Number	Fish Type (Bahasa)	English
2	Belahan Ikan, Kepiting	Cut Fish, Crab
1	Daging Ikan Putih	White Fish Fillet
1	Daging Ikan Tanpa Tulang	Fish Fillet
2	Daging Kepiting Beku	Frozen Crab Fillet
1	Gurita Beku	Frozen Octopus
9	Hasil Laut	Marine Produce
6	Ikan Beku	Frozen Fish
2	Ikan Fillet Beku	Frozen Fish Fillet
1	Ikan Layang	Flying Fish
1	Telur Ikan Terbang Kering	Dried Flying Fish Roe
1	Ikan Kerapu	The grouper
1	Ikan Kuning Beku	Frozen Yellow Fish
3	Ikan Segar	Fresh Fish
1	Ikan Sunu Beku	Frozen Sunu Fish
1	Ikan Tenggiri Beku	Frozen Mackerel
4	Ikan Tuna Beku	Frozen Tuna
1	Ikan Trout Beku	Frozen Trout Fish
3	Kerang Laut	Sea Shells
41	Rumput Laut	Sea Weed
2	Taripang Kering	Dried Sea Cucumber

3	Telur Ikan	Fish Roe
9	Telur Ikan Terbang	Flying Fish Roe
2	Tuna Segar	Fresh Tuna
10	Udang Beku	Frozen Shrimp
5	Udang Segar	Fresh Shrimp
4	Udang Segar Beku	Frozen Fresh Shrimp

Source: Makassar Port Authority

4.4 Shipping Costs

Details of shipping costs from Makassar to various markets in reefer and dry containers are summarized in table 10 below, while in table 11 below information is provided on the cost of shipping from Jakarta to various overseas ports. A comparison of the data highlights the large cost saving from shipping from Jakarta compared to Makassar; more than half the cost to some of the major seafood markets like China.

Table 8: Makassar Shipping Costs to Various Ports

No	Country	Port	Reefer		Time (weeks)
			20’	40’	
			US$	US$	
1	Australia	Brisbane	3,150	6,300	3
2	China	Shanghai	2,550	3,400	2
3	Japan	Tokyo	2,750	5,500	2
4	Malaysia	Port Klang	2,400	4,800	1
5	Singapore	Singapore	2,400	4,800	1
6	Thailand	Bangkok	2,650	3,450	1

Source: Freight Express Makassar Indonesia, Sept. 2007

Table 9: Jakarta Shipping Costs to Various Ports

No	Country	Port	Reefer		Time
			20’ US$	40’ US$	
1	China	Shanghai	1,000	1,500	14 days
2	Hong Kong	Hong Kong	1,100	1,700	7 days
3	South Korea	Busan	1,550	2,250	10 days
4	Japan	Tokyo	1,950	3,400	7 days

Source: Freight Express Jakarta Indonesia, Sept. 2007

The cost to send a reefer container from Makassar to Surabaya is Rp 11.5 million for a 20 foot container and Rp 17.5 million for a 40 foot reefer container. It is only marginally more expensive to send a reefer container to Jakarta from Makassar at a cost of Rp.12 million and Rp 19.5 million for a 20 foot and 40 foot reefer container respectively. The container ship from Makassar to Surabaya will take 2 days and an extra day to Jakarta.

4.5 Seafood Supply and Market Chain

The Indonesian Chamber of Commerce (Kadin) has over 4,000 members in South Sulawesi; 17 members are involved in mariculture export – fish, shrimp, seaweed, sea cucumber.

Case Study – Mr Adam (Fishing cooperative PUSKOPIN)

The central cooperative buys seafood from 18 primary cooperatives located in the districts of South Sulawesi. Each primary cooperative has about 1,500 fishermen.

The central cooperative handles a range of seafood with most sales being frozen fish (35%), seaweed (45%) and sea cucumber (20%). The central cooperative will sort the various seafood products and packs for export or inter island trade. The cooperative has coolroom capacity for chilled (80 tonnes) and frozen (4 tonnes). It has 2 airblasters for the chiller rooms and uses outside freezer storage.

Primary cooperatives do some sorting but the problem is that they do not have access to airblasters to reduce quickly the temperatures of the seafood; this can result in deterioration.

There are about 9 main traders in Makassar of frozen fish sending to Java customers. Frozen fish (small) are sent mostly to Java wholesalers (sold to pasars) and some is exported to China via Surabaya to HK (in the past it was exported direct from Makassar to HK); 3-5 containers per month are sent to China. Other frozen fish is exported to Singapore, Taiwan and Korea. For frozen fish the rejection is low; only 1% - 2%.

Seaweed is exported to many markets with most going to China; total demand is about 1,500 tonnes per month for 2 varieties. China buys seaweed at 25% water content. Seaweed to Korea is 15 x 40 foot containers per month; demand is strong (300 tonnes per month). Seaweed has also been exported to Chile (one time) and Argentina (for 3 years) at 18% water content. The cooperative will pay Rp3,000 per kg for good quality seaweed but if it is not dried according to their advice they pay only Rp1,800 per kg. The PUSKOPIN needs to source sea weed outside its cooperative members to meet contracted demand. Seaweed is bought at an agreed water content (38%) and will need to be repacked if the product does not meet the customer specifications.

They have undertaken some training programs in different districts with some success depending on the “culture” of the district; fishermen want the money quickly and are inpatient so will only dry the seaweed partially so they receive less money but quicker.

The problem for the cooperative is a shortage of financial capital to source and pay for seafood for export. Importers pay on “letters of credit” (LC) after 45 days from shipment so the PUSKOPIN has to mange the capital gap; banks are reluctant to lend to the cooperative for export. If PUSKOPIN does not have the finances to buy the seafood from the primary cooperative they will act as a broker and link them to buyers.

Sea cucumber is sold to Taiwan, Korea and HK with the buying price (BP) paid to the fishermen collector and the selling price (SP) from cooperative (PUSKOPIN) to the trader depending on sizes as follows:

- Small size: BP = Rp280,000 per kg (70% dry); SP = Rp500,000 per kg fob
- Medium: BP = Rp750,000 per kg (60% dry); SP = Rp1.2 m per kg fob
- Large: BP = Rp450,000 per kg (60% dry); SP = Rp750,000 per kg fob

5. SUMMARY OF KEY ISSUES AND CONCLUSIONS

The study has identified a range of opportunities and constraints affecting the growth of the SE Sulawesi seafood industry. These are summarized below.

a. Export demand for seafood is strong. Indonesia is a major producer of a wide range of seafood for export to markets in Asia, USA and EU. Seafood (live fish, lobsters, dried abalone, dried sea cucumber and seaweed) is an important part of the economy of SE Sulawesi as the waters of SE Sulawesi provide fertile ground and a large supply base for wild catch seafood and further potential for farmed seafood.

There are good opportunities to expand the practice of "farmed" seafood as supply of "wild catch" seafood diminishes. There is also an opportunity to introduce regional branding (based on QA standards) to promote the Kendari seafood industry. This could be done through the establishment of a local trading cooperative.

b. Fishermen are not market focused. Fishermen supply to a collector what they catch or produce rather than what the buyer wants. This leads to lower or discounted returns to the fishermen if the seafood doesn't meet specifications on size, freshness or water content.

There is a need for training of fishermen to reduce the mortality of live fish through improved husbandry practices.

c. Traders have the market power. City based traders (from Jakarta, Surabaya or Makassar) control the buying and selling (for export or domestic markets) of seafood from Kendari seafood suppliers. Fishermen from Kendari are then price takers and lack the knowledge of market requirements. In Makassar there is a major fishing cooperative (PUSKOPIN) which provides a vehicle for exchange of information and trade.

There is a need for better communication between traders and fishermen on market requirements.

d. Limited infrastructure. The Kendari port does not have reefer containers or coldstorage facilities unlike the port of Makassar. There is ice making facilities in Kendari for fishermen. Also, traders in Kendari of live fish have holding tanks and packing facilities.

There is an opportunity to introduce packing facilities in fishing communities so that they can hold and pack fish for the market. This will bring the fishermen closer to the market and improve market signals which could lead to an increase in profit per kg of seafood.

e. Involve all Strategic Allies. There are a few local Government departments that provide a service role in the seafood industry in SE Sulawesi.

There is a need to involve all allies in training and market development programs, including Quarantine, the Department of Fisheries and the University.

REFERENCES

Capricorn Indonesia Consult Inc., PT (CIC) Business report, http://www.cic.co.id

Data from Haris Sarita, Lecturer at the Haleuleo University, Kendari

Department of Fisheries and Marine, South East Sulawesi Province

Freight Express Jakarta Indonesia, Sept. 2007

Freight Express Makassar Indonesia, Sept. 2007

Indonesia Bureau of Statistics (BPS)

Interviews with private traders in Kendari (Ramlan, Ali Topan, Edi, Hendra and Haji Hasan)

Quarantine Department in Kendari, South East Sulawesi

APPENDIX ONE - ITINERARY

Visit Program

Phillip Morey

Morelink Asia Pacific

30th April to 6th May 2008

Kendari and Makassar, Indonesia

ACCOMMODATION & FLIGHT DETAILS

Kendari, Indonesia

Hotel Name:	**Imperial Hotel**
Street Address:	Jl. Ahmad Yani No. 77
Telephone:	(+62 401) 391 222
Facsimile:	(+62 401)
Check in:	Wednesday, 30th April 2008
Flight Detail:	JT 788 at 18.00
Check out:	Sunday, 4th May 2008
Flight Detail:	JT 789 at 06.30 a.m.

SCHEDULE / ITINERARY

Kendari ***Wednesday, 30th April 2008***

TIME	CONTACT/LOCATION	COMMENTS
18.00 p.m.		Depart Jakarta to Kendari by JT788

22.40 p.m.		Arrives Kendari
Overnight		Imperial Hotel, Jl. Ahmad Yani No. 77, Kendari. Ph. 0401 - 391222

Kendari ***Thursday, 1st May 2008***

TIME	CONTACT/LOCATION	COMMENTS
	Visited fishing villages surrounding the bay of Kendari with Mr Andrew Winstanley.	

Kendari ***Friday, 2nd May 2008***

TIME	CONTACT/LOCATION	COMMENTS
09.00 a.m.	Dr. Laode M. Aslan Mr Haris Faculty of Fisheries and Marine Science **Haluoleo University** Kendari 93232, Indonesia Mob. +62 813 4151 4869 Email. aslaod66@yahoo.com	
10.30 a.m.	Mr Hamsah, Quarantine	
13.00 p.m.	Visit to the fish wholesale market - Tempat Pelelangan Ikan (TPI)	
14.30 p.m.	Meeting with packer/trader of live fish – Mr Ramland	
16.00 p.m.	Meeting with small abalone and sea cucumber processor / trader	
17.00 p.m.	Meeting with abalone processor / trader – Mr Welly	

Kendari ***Saturday, 3rd May 2008***

TIME	CONTACT/LOCATION	COMMENTS
9.00 a.m.	Meeting with abalone processor / trader – Mr Welly	
11.00 a.m.	meeting with seaweed processor / trader – Mr Hasan	

13.00 p.m.	Meeting with packer/trader of live lobster – Mr Edi	
16.00 p.m.	Meeting with trader of live fish / consultant – Mr Bobby	

Kendari ***Sunday, 4th May 2008***

TIME	CONTACT/LOCATION	COMMENTS

Makassar ***Monday, 5th May 2008***

TIME	CONTACT/LOCATION	COMMENTS
06.30 a.m.		Depart Kendari to Makassar by JT 789
07.20 a.m.		Arrives Makassar
08.00 a.m.	Mr. Adam & Mr. Bora **Pusat Koperasi Pengrajin Ikan (PUSKOPIN) Sulawesi Selatan** Kawasan Industri Makassar (KIMA) VIII No. 9, Makassar (only 10 minutes from the airport) Mob. 0811444199 / Ph. 0411 - 4723189	
11.00 a.m.	Meeting with Kadin (chamber of commerce) – Mr Syahrir and Mr Gazali	
15.00 p.m.	Meeting with exporter of dried abalone – Mr Harry	

Makassar ***Tuesday, 6th May 2008***

TIME	CONTACT/LOCATION	COMMENTS
11.30 a.m.	Meeting with packer / exporter of sea cucumber and seaweed – Mr Ecky	
19.40 p.m.		Depart Makassar to Jakarta by JT 783
21.00 p.m.		Arrives Jakarta

APPENDIX TWO – SEAFOOD QUESTIONNAIRE

Mariculture Survey of Traders in South East Sulawesi (Kendari and Bau Bau)

Name :
Company :
Address :
Phone / Fax :
Email :

Q.1 Which of the following seafood products do you trade?

1. Marine grouper,
2. Spiny Lobster (live)
3. Abalone (processed)
4. Sea Cucumber (processed / dried)
5. Seaweed
6. Pearl Oyster
7. Other

Q.2 What volume of each container (tonnes) do you sell each month? (average per year)

_____

Q.3 Which markets / outlets do you sell seafood products to?
a. Domestic (eg Makassar or Surabaya or Bali or Jakarta or others?)

_____

b. Export (eg Singapore or Japan or others?)

_____

Q.4 Who are your key customers? (Contact Details)

_____

Q5 What are the major problems facing traders in selling seafood?

_____

Q. 6 What are the major problems facing traders in sourcing / buying seafood?

_____

Q.7 Who do you buy your seafood from?

_____

Q. 8 Where are the opportunities for expanding trade in seafood? Which markets? Which products?

_____

Q.9 Do you have coldstorage facilities? What is the capacity (tonnes) for frozen and chilled?

_____

APPENDIX THREE – SUMMARY OF SEAFOOD CONTACTS

- Andrew Winstanley, fisheries business consultant; HP = 081318105800

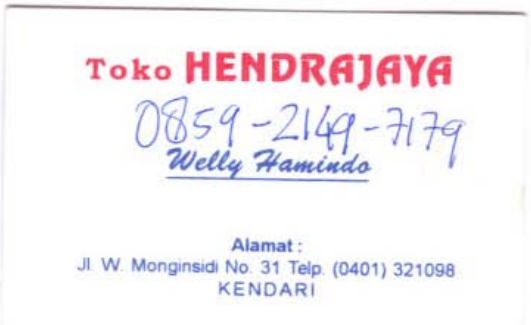
South East Sulawesi

- Johnny Eco (guide to Bau Bau island); HP = 081341884278
- Munsir (guide to Kendari and fisheries); HP = 085241685877
- Ramland (trader in live fish from Kendari to Jakarta to HK); HP = 085241554777
- Dr Aslan, Fisheries Faculty at University Haluoleo (dean); HP = 081341514869
- Haris Sarita, Fisheries Faculty at University Haluoleo (lecturer); HP = 085696074913
- Hamsah, Ministry of Quarantine; HP = 081348507376; TLP = 0401-396383; ski_kdi@yahoo.com
- Welly and Hendra Hamindo, Toko Hendrajaya (abalone and sea cucumber trader); HP = 085921497179
- Edi Topan, UD Sumber Laut (packer and trader of live lobsters); HP = 081341530111
- Hasan Harisah, UD Sumber Makmur (trader of sea weed); HP = 0811408298
- Bobby (live fish trader); HP = 081341883968
- Marwiyah Tombili, foreign aid consultant (good english skills); HP = 0811402264

South Sulawesi

- Ecky Marjuti, CV Sumber Laut (packer / exporter of dried sea cucumber and seaweed); HP = 08124160296
- Harry (export of dried abalone); HP = 0811412288
- Syahrir Nur, Executive Director South Sulawesi Kadin (business association); HP = 08124268073
- Gazali Kahar, Business Information South Sulawesi Kadin (business association); HP = 081543242206
- Sukardy, Black Earth Resources (organic fertilizer/feed); HP = 08152515889
- Bora, manager of Fishing Cooperative SE Sulawesi(Puskopin); HP = 08194100039
- Adam, chief of Fishing Cooperative SE Sulawesi(Puskopin); HP = 0811444199

3.1 Kendari (South East Sulawesi) Business Cards



3.2 Makassar (South Sulawesi) Business Cards

3.3 Bau Bau Seafood Traders

1. Name : Yanto
   Location : Bau Bau
   Export to : Bali, China
   Species : Seaweed, Sea Cucumber, Lobster and Grouper

2. Name : Sahirun
   Location : Wangi – Wangi (Wanci)
   Species : Mix (Mr. Sahirun as a coordinate person to collect /buying seafood product in Wanci

3. Name : H. Abubakar
   CV. Jaya Makmur (Bau-Bau branch office)
   Export to : Hong Kong and Korea (by seafreight)
   Species : Grouper (from several fishermen). 300 – 500 kg per sending

4. Name : Ma'ruf (operator with Hong Kong's vessel
   Location : Bau – Bau, Batara Guru

5. Name : H. Latula
   Location : Tiworo Island
   Species : Mix

6. Name : H. Hardin (CV. Artha Bahari, Bau Bau)
   Species : Seaweed

7. Name : Governor's Founder
   Location : Tapi Tapi (Muna), Perigi District
   Species : Grouper

8. Name : Gusrin
   Location : North Buton
   Species : Grouper

9. Name : L.D. Karimmas
   Locaton : North Buton
   Species : Seaweed

APPENDIX FOUR - SEAFOOD EXPORTS BY COMMODITY AND COUNTRY, 2006

HS	Commodity	Country	Weight (kg)	Value (US$)
1605901000	Abalone, Prepared or Preserved	Japan	10	1
		Hongkong	19,665	48,280
		Korea	10,560	3,696
		Singapore	9,098	24,258
		Philippines	8,806	34,845
		Morocco	2,447	2,631
		Australia	897	1,638
		Timor Leste	30	10
		USA	760,438	1,992,857
		Canada	421,665	1,065,730
		Mexico	14,942	37,400
		United Kingdom	56,857	134,458
		Netherlands	24,078	69,841
		Belgium	17,264	49,750
		Spain	48,539	226,119
		Total	**1,395,307**	**3,691,565**
0306212000	Rock Lobsters and Other Sea Crawfish, Live	Japan	338	4,257
		Hongkong	190,211	859,492
		Taiwan	211,729	867,069
		China	1,926	7,120
		Thailand	81	750
		Singapore	11,896	58,980
		Malaysia	358	9,060
		Vietnam	6	600
		Trinidad and Tobago	1,057	4,390
		Total	**417,602**	**1,811,718**
030621300	Rock Lobsters and Other Sea Crawfish, Fresh or Chilled	Taiwan	160	1,600
		Singapore	107,982	201,825
		Malaysia	360,847	545,570
		Australia	305	525
		Total	**469,294**	**749,520**
0306222000	Lobsters, Live	Japan	2	10
		Hongkong	805,855	5,597,132
		Taiwan	308,084	345,227
		China	3,763	57,613
		Singapore	19,426	44,877
		Malaysia	110	1,180
		Vietnam	2,944	2,186
		Nigeria	126	190
		Australia	64	839
		Total	**1,140,374**	**6,049,254**
0306223000	Lobsters, Fresh or	Japan	75	1,080

	Chilled	Hongkong	5,599	22,051
		Korea	1,162	8,581
		Taiwan	276	750
		China	700	2,100
		Singapore	10,376	21,435
		Malaysia	3,375	4,673
		Total	**21,563**	**60,670**
0307101000	Oysters, Live	Japan	4	38
		Hongkong	1,170	2,524
		Korea	7,538	34,418
		Taiwan	1,050	2,100
		China	35,174	8,188
		Singapore	12,430	25,512
		Vietnam	281	1,053
		South Africa	23	200
		USA	742	2,563
		Canada	374	2,245
		United Kingdom	490	3,295
		France	138	724
		Germany	110	225
		Total	**59,524**	**83,085**
0307102000	Oysters, Fresh, Chilled or Frozen	Japan	39,366	76,905
		Malaysia	900	4,500
		Iran	26,290	24,975
		USA	41,522	72,664
		Total	**108,078**	**179,044**
0307103000	Oysters, Dried, Salted or in Brine	Hongkong	27,756	58,567
		China	44	144
		Singapore	3,824	3,934
		Malaysia	376	1,128
		Vietnam	2,545	6,971
		Canada	280	480
		France	450	90
		Switzerland	2,000	1,668
		Italy	294	96
		Total	**37,569**	**73,078**
0307992000	Beche-De-Mer (Sea cucumber / Trepang), Dried, Salted or in Brine	Japan	1,063	3,730
		Hongkong	665,583	2,033,678
		Korea	178,865	974,262
		Taiwan	4,382	16,668
		China	75,881	202,385
		Thailand	519	1,030
		Singapore	301,850	595,479
		Malaysia	38,149	150,074
		Vietnam	353,927	631,307

		India	100	1,040
		Cyprus	286	375
		Australia	291	2,600
		USA	60,348	170,440
		Canada	50,319	118,133
		Brazil	85	60
		Belgium	15,059	44,153
		Italy	1,511	646
		Total	**1,748,218**	**4,946,060**
1212201000	Seaweeds & Oth Algae Fresh, Chilled or Dried Used in Dyeing, Tanning	Japan	351,891	694,486
		Hongkong	13,189,691	3,380,329
		Korea	989,911	611,068
		Taiwan	356,450	106,145
		China	17,594,022	5,784,580
		Thailand	70,700	46,931
		Phillipines	6,109,239	3,063,196
		Malaysia	234,855	543,441
		Vietnam	3,505,303	790,735
		United Arab Emirates	137	328
		Morocco	60,000	20,000
		Tunisia	305,150	167,825
		Ghana	1,552	1,900
		Australia	268,000	341,150
		USA	3,538,509	1,645,326
		Canada	147,000	82,075
		Mexico	40,000	26,000
		Panama	68,000	44,200
		Chile	2,200,599	1,069,258
		Venezuela	10,000	6,500
		Argentina	1,215,000	673,750
		Brazil	311,150	185,633
		Malvinas	147,900	86,521
		United Kingdom	622,100	1,676,990
		Netherlands	40,000	148,000
		France	603,800	549,100
		Germany	292,350	370,710
		Belgium	104,000	84,600
		Denmark	1,532,874	644,126
		Italy	55,867	9,226
		Spain	4,234,996	1,638,802
		Portugal	261,000	118,770
		Poland	21,000	13,650
		Lithuania / Russia	42,400	83,460
		Total	**58,525,446**	**24,708,811**

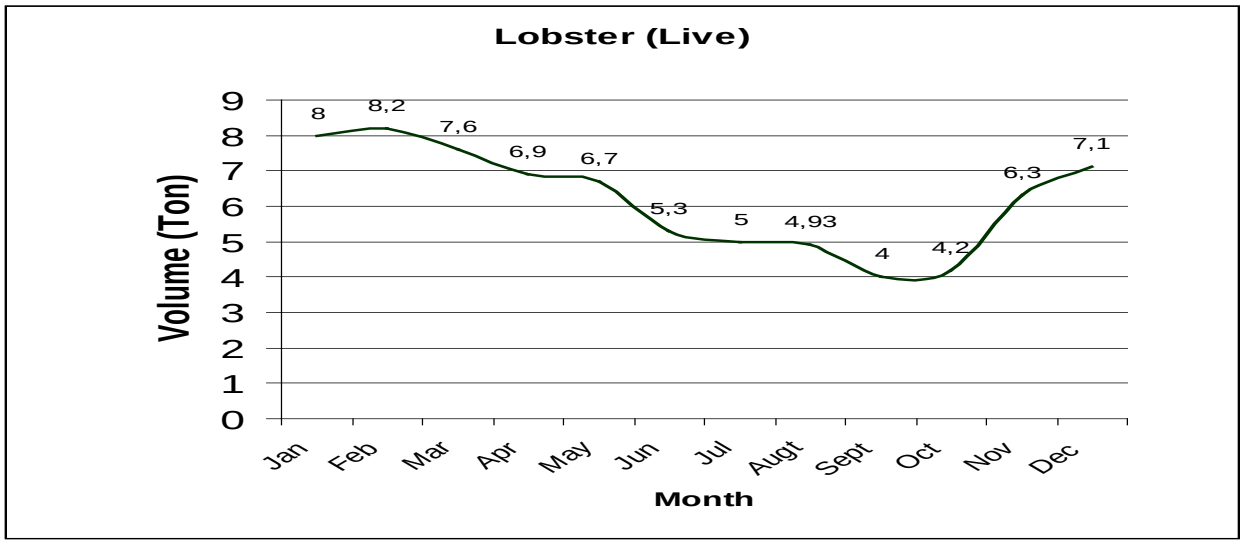
Source: The Indonesian Bureau of Statistic (BPS Book, 2006)

APPENDIX FIVE – SOUTH EAST SULAWESI DATA[9]

A5.1 Live Lobster

In 2007, Mr Topan (a trader from Kendari) exported (via Surabaya) 74.2 tonnes of live lobster (See figure below) with 50% to Hong Kong and 50% to Taiwan.

Figure 7: Live Lobster Exports by Mr Topan by Month, 2007

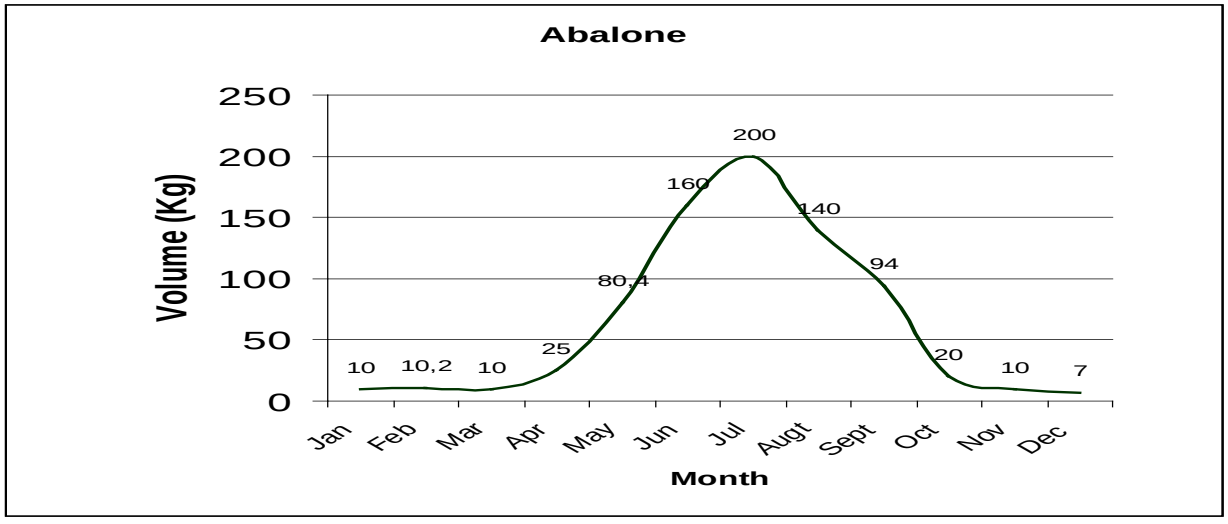


Source: Mr Ali Topan (trader in Kendari)

A5.2 Dried Abalone

In 2007, Mr Herndra exported (via Surabaya and Makassar) 774.6 kilograms of dried abalone (See figure below) with 80% to Hong Kong, 10% to Taiwan and 10% to China.

Figure 8: Dried Abalone Exports by Mr Hendra by Month, 2007



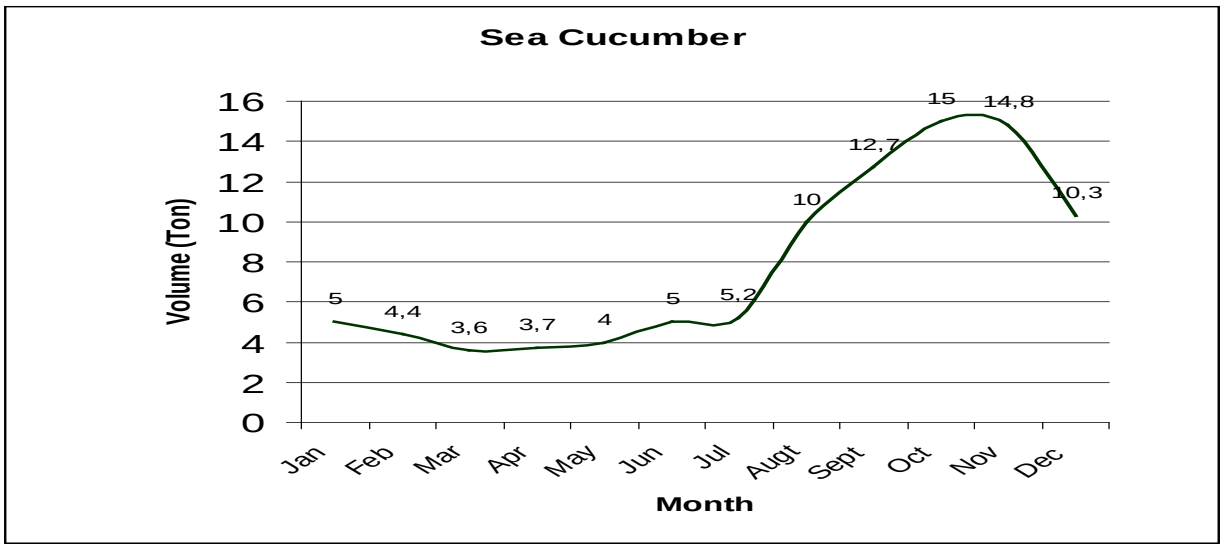
Source: Mr Hendra (trader)

[9] Data collected and analyzed by Haris Sarita, Lecturer from Haleuleo University, Kendari, based on interviews with traders

A5.3 Dried Sea Cucumber

In 2007, Mr Hasan exported 93.7 tonnes of dried sea cucumber (See figure below).

Figure 10: Dried sea cucumber exports from Mr Hasan by month, 2006

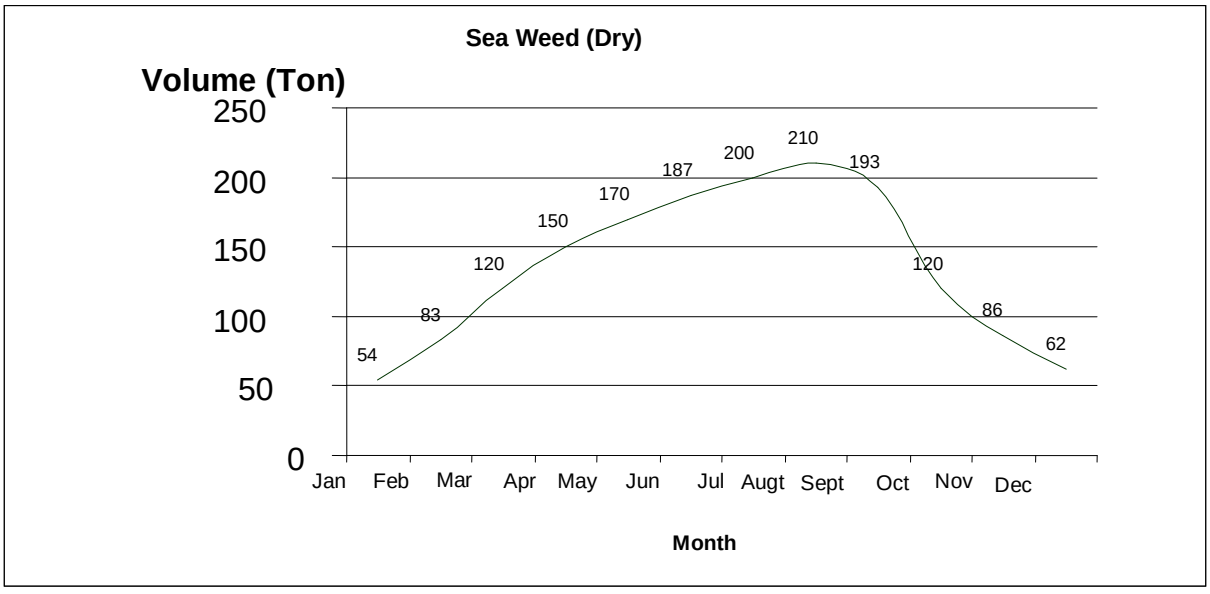


Source: Mr Haji Hasan (trader in Kendari)

A5.4 Seaweed

In 2007, Mr Hasan exported (via Surabaya and Jakarta) 1,636 tonnes of dried seaweed (See figure below) with 50% to Hong Kong, 30% to Philippines and 20% to Europe.

Figure 12: Seaweed Exports by Mr Hasan by Month, 2007



Source: Mr Haji Hasan (trader in Kendari)