The 2nd International Symposium on Marine and Fisheries Research

Preface

The role and significance of fisheries and marine research become more crucial in the future around the world as the ocean covers almost 2/3 of our planet and produces huge resources for human needs. Fisheries and marine resources have crucial roles in providing not only world energy, seafood productions, significance in climate change, marine aquaculture, but also in the world coastal socio-economic dynamics. Fisheries and marine resources serve as main income generating sector for people in coastal area of tropical countries especially in the archipelagic countries such as Indonesia. Department of Fisheries, Faculty of Agriculture, Universitas Gadjah Mada Indonesia organizes a symposium biannually, International Symposium on Marine and Fisheries Research (ISMFR). This symposium is a forum to be the primary focal assembly to share research outcomes and discussions on the role of fisheries and marine scientists in sustaining ocean ecosystems. This 2nd ISFMR was participated by more than 150 participants with a total of 106 presented papers. The symposium also invited the prominent scientists in fisheries and marine science mainly in the topics of marine sciences, fisheries management, aquaculture and fish processing technology. The symposium theme was "tropical marine and fisheries resources in a changing environment" covered broad topics in fisheries and marine science such as aquaculture, fish diseases, fish genetics, biotechnology, oceanography, seafood processing and safety, fisheries biology, climate science, marine ecotoxicology, fisheries management, marine natural product, and fisheries socio-economics.

This proceeding provides an opportunity for readers to engage with refereed papers presented on 24-25 July 2017 of the 2nd ISFMR. The papers published in this proceeding were selected from a total of 106 presented papers. This proceeding is divided into 5 sections, namely aquaculture, marine science, fisheries management and oceanography, fish processing technologies, and fisheries socio-economics. Therefore, in this proceeding, readers might discover the recent issue and results of research in the broad topics of fisheries and marine sciences.

We would like to deeply appreciate all of parties for the successful of the 2nd ISFMR. We deeply express our gratitude for organizing committee, keynote and invited speakers, reviewers, editors, and editing staffs for fully dedication, tireless efforts, and continuing hard work along the conference events and the process of this proceeding publication. We express special acknowledgement for Rector, Dean of Faculty of Agriculture, and Publication Agency of Universitas Gadjah Mada for their consistent and solid support for this conference. We also deeply appreciate all of participants and authors for the excellent participating and taking the best opportunity for disseminating, discussing and publishing the papers. A broad parties and large number of people have to be acknowledged for their crucial contribution for this successful ISFMR. Finally, we hope this proceeding provides the readers up to date and prominent information in fisheries and marine science from various points of view.

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Keynote Speaker Abstracts

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KEYNOTE SPEAKER ABSTRACTS

BIOPROSPECTING OF MICROBIAL SYMBIONTS OF MARINE INVERTEBRATES FOR SUSTAINABLE USE OF CORAL REEFS

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The marine environment is the largest habitat on Earth, representing more than 70% of the surface of our planet. These diverse marine environments still remain largely unexplored, understudied and underexploited in comparison with terrestrial ecosystems and organisms The tropical marine environment is well-known for housing unique and diverse marine invertebrates. Natural products from marine invertebrates greatly expand the chemical diversity available for biotechnological exploitation. One of the most serious bottlenecks in developing natural products from marine sources during the past decades has been the availability of biomass and/or of optimized cultivation conditions to gain sufficient amounts of compound for preclinical and clinical studies. Among the unusual niches for novel microbes are marine invertebrates, which host hundreds of different bacterial groups and contain diverse symbionts. Marine invertebrates are sources of a diverse array of bioactive metabolites with great potential for development as drugs and research tools. Marine invertebrates are the target of the search for marine natural products because their associated microorganism communities occupy a unique niche in the ocean's biota. Since marine diversity also reflects chemical diversity, the isolation of the under-exploited symbiotic bacteria from marine invertebrates offers a great opportunity for discovering novel bioactive compounds based on screening against various disease targets with significant impact and strong potential for treatment of diseases. Therefore, it is reasonable to expect that exploration of untapped marine microbial diversity and resources will improve the rates at which new classes of secondary metabolites are discovered.

SYMBIOTIC BIOLOGY AND FISHERIES OF JELLYFISH IN SOUTHEASTERN ASIA

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Large-sized jellyfishes can harbor a wide variety of eukaryotic symbionts, including protists, cnidarians, platyhelminths, nematodes, nudibranchs, polychaetes, barnacles, copepods, crabs, shrimps, ophiuroids, and fishes. These interspecific interactions can be ordinarily observed in the world's oceans and include dynamic changes in populations of the host and symbiotic groups, often in conjunction with developmental stages of the latter. These symbioses may be classified into two basic types based on the presence or absence of a trophic interaction between them. This can be confirmed through simple gut or stomach-content analyses of the symbionts, or can sometimes be supported by stable isotope analyses. In general, early life-stages of the symbionts tend to utilize host jellyfishes in a complex manner, although some caridean shrimps use the host mainly for breeding. In the case of the former, the host jellyfish plays a role in one or more combinations of vector, vehicle, food collector, food source, or predator shield. For instance, in Indonesia, Malaysia, Thailand and the Philippines, large scyphomedusae were frequently associated with megalopa larvae and juveniles of crucifix crab *Charybdis feriata*, young ophiuroids (e.g., *Ophiocnemis marmorata*), 0-year-old juveniles of shrimp scad *Alepes djedaba*, and juveniles and adults of caridean shrimps (e.g., *Latreutes anoplonyx*). In Southeast Asia, large rhizostome jellyfish are often harvested commercially as a component of Chinese cuisine. The main targeted species are *Rhopilema hispidum*, *R. esculentum*, *Lobonemoides robustus*, *Acromitus hardenbergi*, and *Crambionella helmbiru*. According to recent FAO data, the annual catch of jellyfishes can reach approximately 160,000 metric tons. Although the edible species may also harbor symbionts, fishermen have largely ignored the existence of these organisms, other than fish juveniles. Our data on the prevalence and mean intensity of symbionts in host edible jellyfishes off Thailand suggest they may severely inhibit normal recruitment, particularly the symbiotic ophiuroids due to their firm attachment to the host. In the case of ophiuroids, almost all individuals in jellyfish fishery captures seem to be killed. In contrast, juveniles of shrimp scad can easily escape from large-meshed nets, although relatively large-sized juveniles may enter the interstices of the oral arms of jellyfish when scared, and will be finally killed upon capture. Thus, jellyfish fisheries seem to reduce the numbers of protective hosts available for the symbionts. Therefore, we propose that jellyfish fisheries in tropical waters may greatly influence the recruitment of planktonic, benthic, and nektonic animals, and even the content of whole ecosystems.

AUSTRALIAN RECREATIONAL FISHERIES AND INDONESIAN SMALL SCALE FISHERIES: CHALLENGES AND SIMILARITIES

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As an archipelagic state, Indonesia has vast aquatic natural resources. Opportunities abound for its 250 million people. However, Indonesia faces three major challenges to sustainably develop its fisheries so as to provide economic and social wellbeing. It must eliminate destructive fishing practices (bombing and poisoning) and address other impacts on coastal ecosystems (e.g. pollution). It must improve cold chain management so that safe high quality seafood can be provided to meet domestic and international demand. It must find ways of effectively regulating fisheries. Indonesia has about 2 to 3 million people directly dependent on fishing for livelihoods. Typically, these fishers are small family-operated operations for subsistence or modest livelihoods. Australia has about 5 million persons who enjoy recreational fishing: fishing for sport or to get some food for their families. Both the Indonesian subsistence fishery and the Australian recreational fishery are, in effect, unregulated. In Australia, daily catch limits and size limits apply to certain popular recreational fish species. However, participation rates are unlimited which means that constraints on total catches are few. As for Indonesia, information on total catches and the effects of fishing on the biomass of targeted species, or on the ecosystem more generally (given increasing participation rates for recreational fishers) is scant. Yet Australia has made progress, largely through coordinated awareness raising campaigns, in encouraging conservative practices among the recreational fishing community. Similarly, education and awareness raising, harnessing traditional wisdom (where this aligns with conservative fishing practices) are key to eliminating destructive fishing practices and conserving vitally important fish stocks in Indonesia.

EQUIPPING COASTAL COMMUNITIES TO DEAL WITH CHANGE IN THE MARINE ENVIRONMENT

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People in coastal communities depend on the marine environment for many aspects of well-being such as food security, employment, but also less tangible benefits such as tradition and culture. To develop enduring information that will lead to suitable fisheries management approaches, the integration of natural, social and economic studies, together with stakeholder participation is needed. A more fragmented approach will not achieve the same level of information on feedback between oceanographic, biological change and coastal community impacts which is needed for effective management. For this purpose a comparison was undertaken of coastal communities and stakeholders dependent on marine resources. Survey data was collected from over 1,200 people in coastal communities in six different countries that are hotspots for marine change to uncover how socio-cultural and economic factors relate to sensitivity and how observational, attitudinal and experiential factors influence exposure. The links between exposure and vulnerability to change in the physical and biological environment is considered in different cultural contexts and marine resource management implications are drawn.

CHALLENGES ON FISH DISEASES STUDY IN INDONESIA

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As an archipelago country, freshwater, brackish water and marine aquaculture in Indonesia is one of important main income. Increasing aquaculture production efforts usually faced problems of quality and quantity of the seeds, feeds, market potential, price and the most serious problem is fish diseases as well as decreased in the quality of aquaculture condition. Several fish diseases had led to serious economic and ecological losses to the national aquaculture business. Those diseases were due to parasites, bacteria, viruses infections. The challenges of disease in Indonesia are on the detail understanding of the disease that already exist in Indonesia and the threat of new disease. A more comprehensive study needs to be done to trace the origins of the white tail disease, to determine the mechanism of *Temnosewellia* infection to freshwater giant prawn, *Macrogyrodactylus* infection on African catfish. Some important diseases already exist in the country around Indonesia. Early mortality syndrome is an acute disease in shrimp that is known to spread in many countries including Malaysia and Thailand. Tilapia lake Virus has caused mass death in fingerling *Tilapia* has been known caused ocutbreak recently in Thailand in 2017. Those diseases may spread and threat to aquaculture as new diseases in Indonesia. Cooperation and a more comprehensive approach are needed to uncover the scientific facts of these diseases and of course for its control.

ANISAKID NEMATODES OF MARINE FISHES IN KOREA: PREVALENCE AND THEIR PATHOGENIC POTENTIALS

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Anisakid nematodes belong to Family Anisakidae, comprising 10 genera with more than 60 species. They have indirect, complex life cycles involving various whale species as definitive hosts while marine crustaceans as first intermediate hosts, and fish and cephalopods as second intermediate or transport hosts. Humans can be accidentally infected with these worms by ingesting raw or undercooked fish or squids containing the larvae and the particular source of human infection varies according to the countries. Symptoms include mainly epigastric pain, nausea and vomiting, as well as allergic reactions. Morphological identification of these larvae is difficult because the morphological keys for larval species identification are lacking. Thus, most of the worms from human infection have been conventionally diagnosed as *Anisakis* spp. or *Anisakis simplex* (sensu lato). However, molecular approach has revealed that there are at least 9 species in Genus *Anisakis*. Of these, *A. simplex* (sensu stricto) is widely distributed in the northern hemisphere and the main cause of human infection, particularly in Asia. A sibling species, *A. pegreffii* sympatrically occurs with *A. simplex* in the northern hemisphere, and it is considered another important source of human *Anisakis* infection, particularly in Mediterranean Europe. We have been investigating anisakid nematodes fauna of marine fishes caught around Korean peninsula since 2011. The collected nematodes were identified by PCR-RFLP with subsequent sequencing, and the infection status was evaluated. Interestingly, *A. pegreffii* has been dominantly found from most of the fish species in this study. When these 2 different *Anisakis* species were examined for comparing physical invasiveness *in vitro*, these 2 species had no considerable difference. Moreover, their similar physical invasiveness was confirmed by *in vivo* experimental infection. We recently obtained trancriptomes of these 2 species by high throughput sequencing and employed bioinformatics to characterize them. When their potential allergen and protease gene profiles were compiled and compared, we found different number of putative allergens in each species, but also several novel *Anisakis* allergen genes in both species. For protease profiles, there was no considerable difference in each 2 species. All of these results suggest *A. simplex* and *A. pegreffii* may have no significant difference in terms of their pathogenicity against humans, although the different transcription levels of target genes should be validated at post-transcriptional level. This information will be helpful for epidemiological survey of human *Anisakis* infection.

LOVING THE UNDERLOVED SPECIES THROUGH PRODUCT INNOVATION

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Underloved fish or trash fish are often seen as low-value catch. The difference between a low-value catch and high-value catch is demand for the type and how the fish species is perceived. The list of what consumers like in food is endless, but there are certain trends that usually stands out. Consumers now want fresh, less-processed and semi-prepared raw materials to land in their kitchen as the home-cooking and brown bag lunch trend is back. The changing population demographics plays a big role in the shifting preference for source of protein in the diet. Taste and texture of a fish product can be manipulated using various techniques in product innovation. These techniques involve development of formulation, refining process selection and innovating packaging for the product. Incorporation of functional ingredients and application of suitable processing methods can be beneficial in making the underloved fish more palatable and attractive. Another critical aspect to consider is product promotion and consumer education. This aspect can result in a positive impact on the supply-demand cycle. Thus, the possibilities of transforming trash fish into treasure.

USE OF PREDICTIVE MODELS AND SENSORS TO EVALUATE THE SAFETY AND QUALITY OF SEAFOOD IN SUPPLY CHAINS

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Access to domestic and international markets highly depends on the performance of supply chains that must deliver safe and high quality seafood. This demand is driven by market forces that require companies to implement effective food safety systems across the whole of the supply chain, from production to consumer, and provide greater transparency about supply chain performance and inputs. Companies must also proactively manage expectations of customers, who are increasingly aware of safety. Sensors provide an efficient means to monitor and evaluate supply chain performance, and communicate information about food product characteristics and environments, all of which may have a positive influence on purchasing behaviour. For example, sensors that transmit information about supply chain temperature can influence product acceptance by wholesalers, food safety authorities, and even consumers. Also, many consumers increasingly prefer seafood produced with environmentally-sustainable practices and consideration for animal welfare. Research projects in Tasmania, Australia have demonstrated the value of predictive models and sensors in supply chains for live Pacific oysters (*Crassostrea gigas*) and fresh Atlantic salmon (*Salmo salar*). For oysters, certain importing countries, such as Japan and USA, impose market access limits for the bacterial pathogen, *Vibrio parahaemolyticus*. To help oyster companies better manage supply chains, models for *V. parahaemolyticus* and Total Viable Counts (TVC) growth rates were used to design and monitor supply chain performance. Results showed that *V. parahaemolyticus* replicated above 15°C, and was inactivated below 15°C. The resulting predictive models were extended across Tasmanian oyster companies through a quantitative microbial risk assessment, demonstrating 'sensitive' points in supply chains that maximize quality and safety. A second research project addressed growing markets for Atlantic salmon, and the benefits of predictive models and sensors to ensure optimum shelf-life and safety, including managing potential hazards caused by *Listeria monocytogenes*. Predictive models were successfully produced for fresh whole, head-on, gutted Atlantic salmon, specifically for TVC, *L. monocytogenes* and Quality Index Metrics (QIM), over a temperature range of 0-15°C. These research products provide oyster and salmon industries with tools to increase access to domestic and international seafood markets. In the near future, predictive models and sensors will be coupled with real-time reporting systems, providing seafood companies with important decision-making capabilities that expand their commercial markets.

MOLECULAR INTERACTIONS OF FISH GELATIN WITH POLYSACCHARIDES

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The interactions between proteins and polysaccharides are of increasing interest because they have significant relevance in important biological processes, including elastogenesis, enzyme channeling, and cytoplasm organization, and also have numerous applications in food, pharmaceutical, and cosmetic industries, including encapsulation, texturization, interfacial stabilization, gelation, fat replacement, meat mimesis, and protein recovery. Protein–polysaccharide interactions are either attractive or repulsive in aqueous solutions, depending on the molecular characteristics and mixing conditions. Attractive interactions occur mostly via electrostatic interactions when the two biopolymers are oppositely charged, leading to the formation of soluble or insoluble biopolymer complexes. The formation of insoluble complexes and their subsequent phase separation is called complex coacervation or precipitation for the separation of liquid-state insoluble complexes or solid-state insoluble complexes as fractal aggregates or electrostatic gel, respectively. Fish gelatin is a promising alternative to mammalian gelatin because it can be produced from fish processing by products and has no consumer concerns regarding bovine spongiform encephalopathy or ethnic/religious dietary restrictions. This presentation will discuss the basic features of molecular interactions between fish gelatin and polysaccharides and their applications in food systems.

Peer review statement

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Comparison of three inert markers in measuring apparent nutrient digestibility of juvenile abalone under different culture condition and temperature regimes

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Abstract. A comparative research using three inert markers, chromic oxide, yttrium and ytterbium to measure the apparent nutrient digestibility of experimental feed in juvenile Hybrid abalone (*Haliotis rubra* X *H. laevigata*) and Greenlip abalone (*H.laevigata*) revealed that apparent digestibility of crude protein (AD_{CP}) measured using yttrium and ytterbium in hybrid abalone were significantly different across the treatments. Protein digestibility measured in experimental tanks was higher than those measured in indoor and outdoor commercial tanks, regardless of inert marker used. Chromic oxide led to overestimated AD_{CP} compared to when measured using yttrium and ytterbium. There were no significant interactions between temperature and inert markers when measuring AD_{CP} and apparent digestibility of gross energy (AD_{GE}). However, there was a significant difference of AD_{CP} amongst inert markers when measured in greenlip abalone cultured at two temperatures. While measurements of AD_{GE} calculated using three inert markers shared the same value.

1. Introduction

Determining the nutrient digestibilities of certain feed ingredients is pivotal to provide credible information to formulate a cost effective formulated feed. Measuring nutrient digestibility directly in Haliotids is difficult due to the problems related to the accurate measurements of feed consumed and faeces voided [1]. Digestibility determination can be affected by time between the production of faeces and their collection [2]. If faeces are exposed to water over time, nutrients may leach from the feed and faeces, which may lead to overestimation of AD. Additionally, experimental feeds tend to disintegrate in water, causing collection of whole uneaten feed to be difficult with potential contamination problem between feed and faeces [3]. Therefore, it is requisite to use indirect method by using inert markers that cannot be absorbed by the animal, should pass through the digestive system at a similar rate as the other ingredients, it must be inert and not impede the digestive processes, consistently included into the feed and can be easily and accurately analysed even at very low concentrations, and be nontoxic to people and environment [4, 5].

Economic valuation of mangrove ecosystem: empirical studies in Timbulsloko Village, Sayung, Demak, Indonesia

Economic valuation of mangrove ecosystem: empirical studies in Timbulsloko Village, Sayung, Demak, Indonesia

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Abstract. Ecosystem resilience is the capacity of ecosystems to tolerate disorders without collapsing into different circumstances qualitatively controlled by a different set of processes. A robust ecosystem is one that can withstand shocks and rebuild itself when necessary. This study aims to identify the value of use-based economy and non-use value of current economy; calculating the total economic value of mangrove resources; and provide suggestions and recommendations based on observations in Timbulsloko, Sayung, Demak. The method used is economic valuation with total economic value technique. The sampling technique used non-probability and purposive sampling method. The results showed that the direct use value of mangroves was utilized by fisherman, fish pond farmers, *branjang* catchers, oystercatchers, trap makers, shop owner, grilled fish makers and shrimp chip makers. Indirect use value was derived from function as the breakwater, beach belt and hybrid engineering. Existing value was not less than 10 % of the direct use value. The total economic value was Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha/year. It is need to improve the community awareness to mangrove ecosystem and to the role of breakwater in order to reduce risk disaster and to develop an ecotourism in the area.

1. Introduction

Indonesia is the country with the largest mangrove level in Asia (and in the world), contributing about half the regional level of the mangrove area. Other Asian countries with significant levels of mangroves are (in the order of mangroves) of Malaysia, Myanmar, Bangladesh and India, which, together with Indonesia, account for more than 80 % of the total area of mangrove forests in Asia [1].

The mangrove ecosystem is one of the most threatened on the planet. Mangroves are being destroyed at levels 3–5 times greater than the average rate of forest loss and more than a quarter of the original mangrove cover has disappeared; driven by land conversion for cultivation and agriculture, coastal development, pollution and over-exploitation of mangrove resources. Mangroves are becoming smaller and more fragmented, important ecosystems for goods and services will be reduced or lost.

The consequences of mangrove degradation will then be especially severe for the welfare of coastal communities in developing countries, especially where people rely heavily on mangrove goods and services for daily needs and livelihoods [2].

Approximately 20 % or 3.6 million ha of mangrove areas have been lost since 1980. Approximately 185,000 ha disappeared annually in the 1980s; this number dropped to some 118,500 ha/year in the 1990s and to 102,000 ha/year in the period 2000–2005, reflecting the increased awareness of the value of mangrove ecosystems [1].

Area of mangrove ecosystem in Central Java covering ± 15,184.15 ha (not including Karimunjawa Islands) [3]. The destruction of coastal ecosystems coupled with the existence of buildings that jutted into the sealeads to abrasion. The total area affected by abrasion in Central Java is 6,566.97 ha where the districts of Brebes and Demak become areas affected by abrasion is quite severe. However, arising land or accretion also occurs on the coast of Central Java, which is 12,585.19 ha. Area of the acres land that is the potential in the rehabilitation of ecosystems especially mangrove ecosystem.

At this time, the level of environmental damage that threatens coastal areas is very high. According to a study conducted by [4], mangrove area in Central Java Coastal area of 10,786 ha in which 96.9 % of them are in damaged condition. The mangrove area continues to degrade, so that the mangrove study results in 2014 only get the area of vegetation cover 5,381.15 ha [3].

In the past, Timbulsloko Village; which located on the coast of Sayung District Demak; was an agricultural land and ponds and mangroves along the coast. However, in the 1980s there was a considerable conversion of agricultural land and mangroves due to the opening of ponds. In the 2000s, erosion began to occur on the coast of Timbulsloko Village and by 2013 the village has lost about 400–1300 m of coastal areas. Temporary estimates of the causes of high erosion rates are due to increased tidal intensity, use of wave retaining embankments and loss of mangroves [5].

Timbulsloko is a dynamic area and vulnerable to the threat of environmental degradation. The high rate of mangrove forest decline, the conversion of mangrove ecosystem to farm land and the problem of sedimentation become the main factor changing the ecological and economic function of mangrove ecosystem in Timbulsloko.

This is interesting and requires a research on what makes the reasons people do not want to move and whether there is still an economic side to take from the region. The concept of resilience may be an example of a precise concept that disaster-prone areas will not fall or collapse as they can improve on their own and be helped with community awareness.

The aim of this research are to identify the value of use-based economy and non-use value of existing economy, to calculate the total economic value of mangrove, to provide suggestions and recommendations to the community and local government.

2. Research Methods

The method used in this research is economic valuation with Total Economic Value technique, this method is used to calculate the value of direct and indirect benefit from mangrove ecosystem at research location. Sampling technique using non-probability sampling with sampling technique using purposive sampling method.

The economic valuation method concerns the monetary measurement of a change in one's well-being caused by changes in the quality of the environment [6]. This measurement value is known as Total Economic Value (TEV). Moreover, economic value as measuring the maximum amount a person wants to sacrifice goods and services to acquire other goods and services [7]. The economic value of goods and services is measured by the sum of the will to pay (Willingness to Pay-WTP) of many individuals to the goods or services in question. Economic valuation is about measuring the preferences of the community. The result of the valuation is expressed in the value of money as a way of looking for confidential preferences.

TEV is the sum of the value of use-based economy and non-value-based economic value [8]. UV consists of Direct Use Value, Indirect Use Value and Option Value. Meanwhile, NUV consists of two

components of value that is the bequest value (Bequest Value) and the value of existence (Existence Value).

Several methodological approaches for valuing ecosystems/resources based on the above typology presented by [9]. Most of the approaches are based on a cost-approach on the grounds that the benefits approach is relatively difficult to predict. Some of the best-known methodologies are Effect on Production (EOP) or production analysis and benefit-cost analysis or benefit and cost analysis, where benefits are described by revenue from production. The definition of total economic value can be seen in table 1 [9].

Table 1. Definition total economic value.

No	Type of Value	Definition
1	Direct Use Value	The economic value derived from the direct utilization of a resource/ecosystem.
2	Indirect Use Value	The economic value derived from the indirect use of a resource/ecosystem.
3	Option Value	The economic value derived from the potential of direct or indirect utilization of a resource/ecosystem in the future.
4	Bequest Value	Economic value derived from the benefits of conserving resources/ecosystems for the benefit of future generations.
5	Existence Value	The economic value derived from a perception that the existence of an ecosystem/resource exists, regardless of whether the ecosystem/resource is utilized or not.

3. Results and Discussion

Demak as one of the districts in Central Java lies in the coordinates of 6°43'26"–7°09'43" South Latitude and 110°27'58"–110°48'47" East Longitude. Demak is adjacent to Jepara and the Java Sea in the North, Kudus and Grobogan District in the East, Grobogan and Semarang District in the South, Semarang City in the West. The farthest distance from West to East is 49 km long and from North to South along 41 km. Administratively the area of Demak District is 89,743 ha, consisting of 14 sub-districts, 243 villages and six urban villages.

In this research, Timbulsloko village was chosen as research location with Dusun Wonorejo and Dusun Bogorame as a specific research area. Timbulsloko Village is a village located in Sayung Sub-district, Demak District. Located in the Western part of Demak, adjacent to Semarang City and the Java Sea. The population in Timbulsloko village is 3,469 people, has an area of 4.61 km^2, consists of four sub-village.

Coastal areas in Timbulsloko were formerly agricultural land, ponds and mangroves [5]. However, in 1980, there was a large-scale conversion of agricultural land and mangroves in the pond. This triggered abrasion along the coast of Timbulsloko which began in 2000. In addition to the loss of mangroves, abrasion is caused by the increased intensity of the tidal wave. All sub-villages in Timbulsloko are affected by abrasion. However, Bogorame suffered the most from other areas. Many locals work as tambak farmers, although abrasion has damaged much of the aquaculture in the village. Most are in Karanggeneng and Wonorejo. Fishermen are found to be in areas close to the sea, especially in Wonorejo

The result of the research shows that there are some activities or work that utilize or intersect with mangrove ecosystem that is the fisherman, farmer, *branjang* catcher, shrimp catcher, processed fish

maker, trap maker and also warung. Most of them have main income as fishermen and fish farmers. Work as fishermen and farmers, of course, a bit much tangent to the mangrove ecosystem. For fishermen, mangroves are where small fish take shelter before reaching adult size, while for farmers is a protector of the waves.

Much attention was devoted to four villages in Sayung Sub-district, Demak District, Morodemak, Purworejo, Surodadi and Timbulsloko village. Coastal rehabilitation programs such as mangrove planting, making wave breakers, hybrid engineering or sedimentation tools installed along the coast and making beach belts. Mangrove planting program is mostly done in Timbulsloko village, Sayung Sub-district, Demak District, for example from Marine and Fisheries Department.

Mangrove is destined to be a natural fortress for coastal areas. With expanding mangrove forests, it is expected to strengthen the area of Timbulsloko Village, Sayung Subdistrict, Demak District. Public awareness should also be improved on the importance of mangrove for coastal areas. Not only useful as a natural fortress, but mangroves also have benefits that can be felt directly by the community.

Table 2. Direct use value.

No	Description	People	Income (rupiah)		
			Daily	Month	Year
1	**Direct Use Value**				
	Fisherman	20	150,000	90,000,000	1,080,000,000
	Fish pond farmer	24		8,400,000	403,200,000
	Branjang catchers	10	75,000	22,500,000	270,000,000
	Oyster catchers	10	100,000	30,000,000	360,000,000
	Trap makers	1	75,000	1,500,000	18,000,000
	Shop owner	1	100,000	3,000,000	36,000,000
	Grilled fish makers	1	50,000	1.500,000	18,000,000
	Shrimp chips maker	1	75,000	2,250,000	27,000,000
	Total				2,212,200,000

The direct use value of the mangrove ecosystem in Timbulsloko Village, Sayung District, Demak District with an area of 31.44 ha is Rp. 2,212,200,000/year or Rp. 70,362,595.42/ha/year (table 2). Direct benefits calculated from the fisheries sector, namely fisherman, fish pond farmers, *branjang* catchers, oyster catchers, trap makers, shop owner, grilled fish makers and shrimp chip makers.

The indirect use value of the mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District was obtained from the cost of making breakwater, seawall and hybrid engineering (table 3). Breakwater located in Timbulsloko Village is help from the Department of Marine and Fisheries of Central Java Province. The seawall is a relief from the Environment Agency of Central Java Province. The hybrid engineering tool is the result of cooperation between the government of Indonesia and the Netherlands.

Table 3. Indirect use value and option value.

No	Description	Area	Value (rupiah)
1	**Indirect Use Value**		
	Breakwater	180 m	900,000,000
	Sea Wall	980.8 m	1,286,276,000
	Hybrid Engineering	1.2 Km	1,200,000,000
2	**Option Value**		
	Mangrove forest	31.44 ha	6,263,038.94

To get the benefits of biodiversity than the value of biological diversity mangrove in Timbulsloko Village, Sayung Sub-district, Demak District multiplied by the average value of US $ 1,500/km^2/year or the US $ 15/ha/year [10]. The total area of mangrove forest located in Timbulsloko Village, Sayung Sub-district, Demak District reached 31.44 ha. If multiplied by the biodiversity value of mangrove forest in Indonesia US $ 15/ha/year, then the value of ecosystem choice of mangrove forest reached the US $ 471 or Rp. 6,263,038.94/year.

The value of the existence of mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District was estimated using contingent valuation method technique. This method is used to ask the community how much value or price given for mangrove ecosystem remains maintained. From the calculation results can be seen that the value of existence for people who are around Timbulsloko, has an existing value of Rp. 535,471,600/year with an average value of Willingness to Pay (WTP) of Rp. 471,000/family/year (table 4).

Table 4. Non-use value.

No	Description	Value(rupiah)
1	**Bequest Value**	**535,471,600**
	average value of WTP	471,000
2	**Existence Value**	
	10 % direct use value	221,220,000

Mangrove ecosystem as an existence has a very high value. Accordingly, it is estimated that the existence value is not less than 10 % of the direct use value of ecosystem mangroves [10]. Therefore it is estimated that the existence value of mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District is 10 % × Rp. 2,212,200,000 = Rp. 221,220,000/year. Total economic value (Total Economic Value) is based on the results of the identification of all types of benefits from the mangrove ecosystem in Timbulsloko. The calculation result of Total Economic Value of mangrove ecosystem is Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha / year.

Suggestions and recommendations that can be given are addressed to the community are utilize the mangroves as the ingredient for edible product, as coastal protection and supporting the recreation sector. Based on observations in the field, the use of mangroves that can be directly used cannot be done continually. Some woman which mostly fisherman's wives said that the mangrove could be processed to be mangroves crackers. Seeing the building of breakwater, sea wall and also *Hybrid Engineering* structure, it can be seen that the effort done by the government to protect Timbulsloko Village area, Sayung Sub-district, Demak District is very good. It would be better if accompanied by a wider public awareness of the importance of these programs so that in the future people in Timbulsloko are more concerned about the environment and also understand about the usefulness of various programs. Community assistance is needed regularly and also learning for children about the importance of loving the coastal areas and also care for mangrove trees. Another thing that might be taken into consideration for the future is recreation. Seeing the intensity of coastal rehabilitation programs as well as research conducted on the impact of the program, it is undeniable that the region is heeded. Coastal areas and mangrove have been like can not be separated in the village area Timbulsloko, District Sayung, Demak District. So, look at it, the need for the utilization of Timbulsloko into Ecotourism area that can be adopted from the Mangrove Tourism Area Mangunharjo Village, Tugu Sub-district, Semarang City.

It can be started first and reinforced by village regulations that are integrated with the local government so that people can better care for the environment and open themselves to the concept of ecotourism. Citizens who want to enter the seaside area and enjoy the beauty of the afternoon above the structure of the breakwater can provide extra money. Then the fisherman who owns the vessel can rent out to just around the mangrove area. It can be started first and reinforced by Village Regulations that are integrated with the local government so that people can better care for the environment and

open themselves to the concept of ecotourism. Citizens who want to enter the seaside area and enjoy the beauty of the afternoon above the structure of the breakwater can provide extra money. Then the fisherman who owns the vessel can rent out to just around the mangrove area.

4. Conclusion

The mangroves ecosystem provides direct use value which was utilized by the fisherman, fish pond farmers, *branjang* catchers, oyster catchers, trap makers, shop owner, grilled fish makers and shrimp chip makers. Indirect use value was the function of mangroves as the breakwater, beach belt and hybrid engineering. The option value is obtained from mangrove forest area multiplied by the US $ 15/ha. The Bequest value is obtained by using the contingent valuation method technique. Existence value is not less than 10 % of the direct use value. Total Economic Value that exist in the mangrove ecosystem in Timbulsloko Village, Sayung Sub-district, Demak District. Rp. 6,361,430,639/year or about Rp. 202,335,580.1/ha/year. Therefore, the suggestions and recommendations for the community in Timbulsloko Village are utilize the mangroves as the ingredient for edible product, as coastal protection and supporting the recreation sector.

References

[1] FAO 2007 *The World's Mangroves 1980–2005* (FAO Forestry) pp 153
[2] UNEP 2014 *The Importance of Mangroves to People: A Call to Action* ed van Bochove J et al. (Cambridge: United Nations Environment Programme World Conservation Monitoring Centre) p 128
[3] Dinas Kelautan dan Perikanan Jawa Tengah 2016 *Kerangka Acuan Kerja (KAK) Rehabilitasi dan Konservasi Sumberdaya Kelautan dan Perikanan Tahun 2016* (Jawa Tengah: DKP)
[4] Badan Perencanaan Pembangunan Daerah Kabupaten Demak 2009 *Laporan Akhir Revisi Rencana Tata Ruang Wilayah Kabupaten Demak 2010-2030* (Demak: BPPD)
[5] Astra A S, Etwin K S, Arief M H, and Maulana M B 2014 *Keterlibatan Masyarakat Dalam Pengelolaan Pesisir dan Laut. Studi Kasus: Kawasan Perlindungan Pesisir Desa Timbulsloko, Kecamatan Sayung, Kabupaten Demak* (Bogor: Wetlands International Indonesia)
[6] Sathirathai S 2003 *Economic Valuation of Mangroves and the Roles of Local Communities in the Conservation of Natural Resources: Case Study of Surat Thani, South of Thailand EEPSEA Research Report* (Singapore: IDRC.ARCHIV 108378)
[7] Fauzi A 2006 *Ekonomi Sumber Daya Alam dan Lingkungan* (Jakarta: Gramedia Pustaka)
[8] Freeman III A M 2003 *The Measurement of Environment and Resource Values Resource for the Future* (Washington DC)
[9] Barton D N 1994 *Economic Factors and Valuation of Tropical Coastal Resources* (Norway: University of Bergen) p 128
[10] Ruitenbeek H J 1991 *Mangrove Management: An Economic Analysis of Management Options with A Focus on Bintuni Bay, Irian Jaya* (Canada: Dalhousie University Printing Center)