

# World News of Natural Sciences

An International Scientific Journal

WNOFNS 22 (2019) 119-128

EISSN 2543-5426

---

---

## Climate Change and Its Possible Food Security Implications Toward Indonesian Marine and Fisheries

**Achmad Rizal\*** and **Zuzy Anna**

Socio-Economic Fisheries Studies Center, Faculty of Fishery and Marine Science,  
Universitas Padjadjaran, Jl. Raya Bandung Sumedang Km. 21, Jatinangor,  
Jawa Barat 45363, Indonesia

\*E-mail address: achmad.rizal@unpad.ac.id

### ABSTRACT

Climate change poses special challenges for decision makers in Indonesia related to inherent uncertainties in future climate projections and the intricate relations between climate change, physical and biological systems, and food security. At present, however, coastal and marine subregions do not have the adaptive capacity needed to overcome this challenge. This paper examines the impact of climate change on food security in coastal and marine Indonesia. It aims to inform decision makers with up-to-date information about vulnerability to climate change, and to facilitate the development of adaptation strategies informed by the experience and knowledge of experts. Climate and extreme weather hazards associated with the coastal and marine sectors cover different factors but are related to sea level rise, rising coastal water temperatures, and tropical storms and hurricanes. Potential vulnerabilities for coastal zones include increased coastal erosion which causes changes in coastline, loss of coastal wetlands, and changes in fish profiles and other marine life populations. Adapting to climate change will ultimately require more systematic integration of governance strategies, science, regulatory systems, policy, and economics at an international level to deal effectively with the wide range of impacts projected for Indonesia. This integration will be shaped through formal mechanisms such as the development or modification of laws, regulations, and policies.

**Keyword:** food security, economic, social, climate change, coastal and marine resources

## 1. INTRODUCTION

Food security has been an emerging issue worldwide, especially in its relation to world food price volatility, climate change, food fuel conversion, and the incomparable increasing of world's food demand with population. Food security has improved significantly in recent decades, but challenges remain to the future stability of the Indonesian food system. While on the absolute indicator side, for example, the Global Hunger Global Hunger Index reported by the International Food Policy Research Institute (IFPRI), Indonesia's position declined from the medium hunger rate at 19.1 to 22.1 in 2016 and 22 in 2017. Index numbers above 20 indicate that there has been a famine at a serious level in a part of the population, especially toddlers, due to malnutrition, lack of weight and stunting. While it has not reduced hunger at the same rate as other South-East Asian countries, such as Thailand and Vietnam, it has made considerable efforts to combat food insecurity.

Largely due to the fear of supply disruptions, Indonesia announced its intention to meet 90 per cent of its food needs from domestic sources by 2014. As FDI forecast in 2013, this highly ambitious goal has not been achieved. Most food-crop farmers are smallholders and face problems of economies of scale. It will be difficult for the industry to increase production to meet self-sufficiency targets, particularly when climatic conditions become increasingly variable as a consequence of climate change.

Since taking office in 2014, President Joko "Jokowi" Widodo has pursued policies that he believes will make Indonesia self-sufficient in key food products. He has reduced or delayed the importation of raw sugar, beef, corn and rice in the hope of spurring increased production. Instead of pushing up production, however, these policies have resulted in supply shortages and price rises. Continuing to promote self-sufficiency policies, instead of sustaining programmes that gradually increase agricultural productivity, have the potential to reduce food security.

The ongoing demographic transition poses a potential problem for the food supply. The Indonesian middle class is currently the fourth largest in the world, after the US, India and China (Rizal et.al., 2017). In 2014, 17.3 million households were identified as middle class. By 2030, if current growth trends continue, 20 million households are likely to belong to the middle class. As the middle class grows to occupy a larger portion of the population, a shift in food preferences is likely to follow. Middle class consumers are more likely to purchase higher-cost food products, such as meat, dairy and processed foods, which Indonesia will struggle to supply through domestic production alone. Indonesia will continue to rely on foreign imports to meet domestic demand in key food products such as rice and beef.

As we all may aware, climate change and natural disaster pose a major threat to the effort of achieving global food security. In the case of Indonesia, added with high growth rate of population, those factors create multi faceted challenges in maintaining sustainable food security. On the supply side, high population growth rate creates stiff competition on the use of land and water, which at the end may reduce food production capacity (Rizal et.al, 2018). Meanwhile, at the same time, quantity, quality, and diversity of food demand are increasing continuously. In order to keep up with the dynamic condition nationally, regionally, and globally, in 2012, Indonesia has successfully revised its previous food law (Food Law 9/2007 became Food Law 18/2012), which is mainly aimed to achieve food security, sovereignty and resilience both as a nation and an individual as well.

Basic policy for the achievement of sustainable food security is a sincere commitment to meet the demand of the food of the entire populations through the optimum used of domestic

resources (Rizal (b), 2018). Therefore, the government has the responsibility in giving the incentives to produce; enhance research activities and the utilization of agricultural technology and innovation; accelerate technology dissemination to smallholder farmers; maintain the stability of staples food supplies and prices; develop staple food reserves in the central, regional and community; and also increase the efforts to achieve food safety.

Based on this new law, we are in the process to have a stronger institution of food security, that is directly under the supervision of the President of the Republic of Indonesia to execute the policy related on food security. Indonesia understands that the impact of climate change is multi-dimensional. Most devastating will be the development costs of climate change. Progress made on various internationally agreed development goals including the MDGs will be threatened should mitigation and adaptation measures not be taken to address the adverse impact of climate change.

In this context, our endeavors in fashioning a response to climate change must be guided by the need to address the development costs of climate change, such as mitigating the increase in poverty, communicable diseases, child mortality, and reduction in access to education and health services. The compounding of these challenges will have serious consequences on the development prospects of developing countries.

## **2. METHOD**

When describing the theory of the Climate change Effect a descriptive method will be used. For this purpose appropriate literature will be employed. The chosen literature for the descriptive section consists mainly of various impact of climate change literatures. The sources in use complement each other and I have tried to form a general picture of the theory of the impact climate change Effect toward Marine and fisheries.

This framework describes the data pipeline to generate a corpus of semantically labeled entities which all subsequent analysis will be based on. The high-level steps of this technical framework are as follows: First, we construct a database of Climate change entities from different literatures (such as university or research institutions) and a second database of mass-media newspapers with diverse orientations. Then, we search for a subset of these entities on the selected newspaper domains in dynamically adjusted time periods and gain article URLs stored in a database. We also extract various meta-information from the articles (such as the article date). Subsequently, we extract the raw entities from the text and match them with our previously defined entity corpus. Finally, the information of these entities based on their textual context are computed. This last step relies on state-of-the-art literature review analysis and approaches.

## **3. CLIMATE CHANGE: MULTIPLE CHALLENGES**

The major source of concern of developing countries associated with climate change is the anticipated negative effects on their economies and development prospects. For Indonesia, some of our core concerns include:

- 1) **Coastal populations and critical infrastructure:** Marine life and coastal area may be greatly impacted by climate change. Coastal populations worldwide may experience

first hand the adverse impacts of sea level rise caused by climate change. With a coastline of some 80,000 km, 17,000 islands and 240 million inhabitants, the impact of sea level rise is of the highest concern to Indonesia. Much of Indonesia's population, industries, infrastructure, and most fertile agricultural lands are concentrated in low-lying coastal areas (Rizal (a), 2018). Approximately 60% of all Indonesians live in coastal areas and low-lying coastal cities. Receding coastlines and submergence of large areas could result in mass internal migration, amplifying existing population pressures.

- 2) **Effects of shifting fish species distribution on fisheries,** Large-scale changes are anticipated in the capture fisheries sector as climate change alters the distribution of fish and total fish catch. Certain fish species are undergoing a shift in distribution as a consequence of ocean warming, including commercially important fish species. Cheung et al. (2013) reported that regions in the northern hemisphere could largely gain in catch potential, while many tropical and subtropical regions may lose. Changes in distribution are expected to affect especially tropical and polar fish. Further taking into consideration that most fish stocks are fully exploited, over-exploited or collapsed and that the global marine catch has reached or even exceeded its biological limits, it is hard to imagine how we can either prevent fish-dependent communities from experiencing a grave decline in the nutritional quality of their diets, or how we can provide a rapidly growing population with ample fish protein (Pauly & Charles, 2015). Many turn to aquaculture as a savior because the sector has expanded around 8.3 percent per year, making it the fastest growing food production system (Pauly, D. & Froese, 2012; Zeller et. al., 2015). However, aquaculture has its own set of issues to deal with as its growth has relied heavily on the availability of fishmeal and fish oil from wild catches while the efficient use and sharing of those products represents a major hurdle for the sector.
- 3) **Agricultural productivity and decreased incomes:** Climate change-induced food production losses could drastically increase the number of undernourished people and hinder progress against poverty and food insecurity. In Indonesia, a delay in the wet season and a temperature increase beyond 2.5 °C is projected to substantially drop rice yields and incur a loss in farm-level net revenue of 9 to 25%. Sea level rise is also likely to decrease fisheries production.
- 4) **Loss of biodiversity:** Species extinction may lead to harmful effects on agriculture, fishery and forestry, resulting in threats to food security and livelihoods. Climate change could subject Indonesia's ocean water to an increase in temperature of 0.2 to 2.5 degrees Celsius, which has the potential to negatively impact the 50,000 km<sup>2</sup> of coral reefs in Indonesia, about 18% of the world's total.
- 5) **Drought and flooding:** An overall shift of the seasonality and timing of rainfall could lead to unpredictable and uncertain water availability and consequently, uncertain ability to produce agricultural goods and economic instability.
- 6) **Human health:** The direct and indirect consequences on health caused by climate change may increase the potential occurrence of infectious disease epidemics. This could further impede in meeting development objectives due to loss in productivity caused by sickness and economic cost associated with budgetary implication in health sector.

The multiple challenges and impact of climate changes requires a multi-pronged approach, yet synergic and coherent, in addressing climate change. While the UN process under the United Nation Convention on Climate Change (UNFCCC) must be fully supported to bring about successful result, other process such as that of the Major Economies on Energy and Climate (MEF), should also be encouraged to help feed into and make the climate change talks under, the UNFCCC achieve desired result.

Also important as part of a multi-pronged approach is sectoral initiatives such as mitigating and adapting the impact of climate change on forests and marine resources. In the context of forest, there have been many efforts through The United Nations Forum on Forests (UNFF), The International Tropical Timber Organization (ITTO) and other international forest organizations towards effective forest management as part of mitigating and adapting to climate change. On management of marine and ocean resources was an important effort to integrate coastal and ocean management approach to promote resilience, in the effort to mitigate and adapt to the effects of climate change on the ocean. These sectoral initiatives must be an integral part of the multi-pronged approach and feed into the global efforts in addressing climate change under the UNFCCC. In this context, the need for financial resources and incentives to further assist developing countries' efforts in promoting diversified, environmentally sustainable livelihood options for forest and coastal communities most vulnerable to climate change should not be overlooked.

### **3. 1. Security and Climate Change**

The security dimension of climate change should not be seen exclusively in terms of military conflict, endangering and threatening international peace and security that requires the attention of the Security Council. Indonesia is cognizant that the impact of climate change is multi dimensional and may include possible security implications. However, Indonesia does not fully share the view that there is therefore an automatic and direct impact of climate change to *international* peace and security. First and foremost, there is a need to clearly identify the security dimension of climate change, including whether it is in fact of such magnitude to threaten international peace and security, thereby warranting Security Council's attention. Gathering the relevant data and establishing a direct link between climate change and its security implications, requires further study and cooperation by all nations.

Indonesia is of the view that the security dimension of climate change relates principally to its *developmental* consequences. The departing point of the security dimension of climate change must come from the recognition that at the heart of climate change is a core development challenge that carries potentially serious implications to development efforts.

To illustrate, food security is a critical area which is expected to be impacted by climate change and should receive the highest priority. Indonesia has taken some steps to address food security on a national scale and at the international level. We recognize that food security entails an integrated approach which should include effective management of land and marine resources. As part of Indonesia's national food security efforts, targets on self-sufficiency for several important food commodities have been set: rice production since 2005, corn (2008), sugar (2009), beef (2010), soybean (2012). The Government of Indonesia has also initiated with six other countries the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security.

It is pertinent to also mention energy when addressing climate change. Energy is crucial for all aspects of development. Yet billions go about without reliable energy services. The current model of energy production and use is nearing its limits and there is a glaring need to

find affordable and viable options for energy. Climate change could be one of the avenues to stimulate more efforts into new and renewable sources of energy, thus contributing to global energy security.

As the world's largest archipelagic state, Indonesia faces unique challenges that complicate its food distribution system (Rizal & Nurruhwati, 2018). Transporting food throughout its 6,000 or so inhabited islands is a particularly difficult undertaking that the government has long grappled with. The food distribution network is one of the largest barriers to food security and increased consumption of domestically produced food. In 2013, the government announced that it was willing to invest in ships to increase inter-island connectivity. Jokowi maintained the government's desire to increase Indonesian connectivity as a key plank of his maritime doctrine when he was inaugurated in October 2014. His policy seeks to transform the waters that divide the Indonesian archipelago into bridges that draw them closer together.

### **3. 2. Roadmap to the future**

The global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities as well as their social and economic conditions (Rizal et. al., 2018).

It is critical that this issue be continually be discussed with a broad perspective, inclusive of all stakeholders in a multilateral forum. The United Nations is the most effective and inclusive forum to discuss climate and the set of related global challenges it poses, with the United Nations Framework Convention on Climate Change as the leading institution of the UN that should address this issue.

Climate change promises serious negative impacts on coastal and marine systems. These same systems and the natural resources that support them are already under severe strain from over-exploitation, the current climate, and multiple other stresses. Many of the world's most vulnerable people depend directly on these systems for their food and livelihoods; and many countries' economies are also highly dependent on them. Fisheries and Marine resources are also adding to the climate change problem.

We are at a crossroads in the development of our planet. The decisions we make now, for marine and natural resources as well as for other sectors, may prove to be the most important decisions humankind ever collectively makes. The two groups that stand to lose the most if the wrong decisions are made – the world's poor, and future generations – are, ironically, the same groups who are least responsible for climate change and who have the least voice in the debate. Food security is one of the basic human rights that is in jeopardy. Today, an estimated one billion people – more than one person in six – do not enjoy that right; without significant changes to agriculture, fisheries and other natural resource-based systems, hunger and poverty will be perpetuated long into the future, and affect many more.

Fish is a major source of protein for many Indonesians and many households rely upon fishing for their primary source of income. At 32 kilograms per person per year, fish consumption is almost double the global average of 19 kilograms per person per year. Approximately 54 per cent of animal protein consumed by Indonesians comes from fish and seafood. In small, remote islands fish contribute up to 90 per cent of the protein requirements of local populations. Growing rates of illegal, unreported and undocumented fishing have damaged the domestic fishing industry by contributing to the lowering of wild fish stocks.

Fisheries are incredibly important to maintaining Indonesian food security. Protecting fisheries, both on and offshore, has been a major priority for successive Indonesian governments. Susi Pudjiastuti, the current Fisheries Minister, adopted a radical approach to remedy some of the challenges faced by the fishing industry. Over-fishing is a problem in Indonesian waters and while regulations exist, they have proved difficult to enforce. In late 2014, Ms Pudjiastuti banned large foreign fishing vessels and the transhipment of fish at sea, restricted commercial fishing and destroyed illegal fishing vessels. Since these policies were introduced, economic growth in the fishing industry has reportedly increased by 40 per cent. Ensuring that fishing regulations are properly enforced will go some way toward protecting the industry, however, other methods of fish production, such as aquaculture, will need to be considered.

Aquaculture has long existed in Indonesia. There are reports of brackish water aquaculture being practiced in western Indonesia as early as the 1400s. According to the Ministry of Marine Affairs and Fisheries, aquaculture is a major source of fish for the country. As wild fish stocks face increasing pressure from overfishing and climate change, aquaculture could become an important industry for maintaining a stable supply of fish (Cao, 2013).

Barriers to the widespread adoption of aquaculture remain, however, limiting Indonesia from achieving its full potential as a major fish producer. About 95 per cent of fish production comes from artisanal fishers, who largely continue to practice traditional methods (Pauly & Froese, 2015). If the industry is modernised, it could provide the country with a greater degree of food security and offer access to a lucrative export market (Garibaldi, 2012).

We know what to do to raise our chances of a better future. Building on several decades of research by the science centres and their partners, we know how to make natural resource-based systems more productive and more sustainable (Rizal & Nurruhwati, 2019). Even without climate change, we have a moral imperative to turn this knowledge into action. Climate change adds urgency to the situation, but it also provides an opportunity. The products of fisheries and marine research are ready to be implemented in adaptation and mitigation strategies that will help people build successful livelihoods despite changing conditions.

Emerging transboundary issues identified by the scientific community will inform future project planning, including, but not limited to ocean acidification, high seas exploration, blue carbon restoration, deep-sea fishing and seamount habitat conservation (Harper et. al., 2013). At the same time, increasing emphasis on private sector engagement and sustainable development will ensure strong governance regimes.

The action plan identifies fisheries authoritative party's role and contributions in addressing the constraints to achieving the goal of sustainable food security, which are (i) stagnating fish productivity and production; (ii) lack of access to rural finance, infrastructure, technology, markets, and nonfarm income opportunities; and (iii) threat of climate change and volatility of food prices. In addressing these constraints, the operational plan focuses on three areas of influence—productivity, connectivity, and resilience (Figure 1).

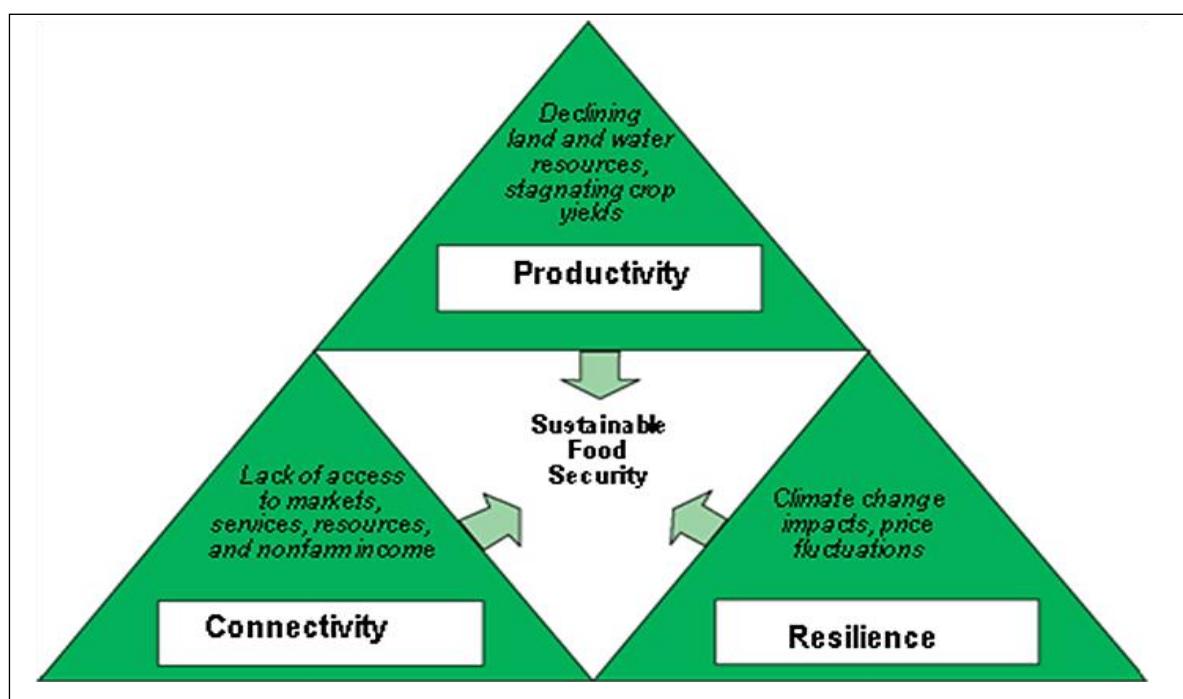
The interventions in these areas of influence will help developing member countries (DMCs) strengthen inclusive fish and aquaculture value chains that enable integration of production, processing, markets, and distribution networks; and promote improved farm and nonfarm employment opportunities, increased incomes, and better living standards of the poor, women, and other vulnerable groups.

To realize this target, the following measures will be implemented:

- 1) Adopt a multisector approach to address the key constraints to food security, particularly

those affecting the poor, women, and other vulnerable groups, using and seeking greater synergy in the lending and nonlending instruments of Strategy 2020's main areas of operation.

- 2) Expand and deepen partnerships on sustainable food security with other donors and specialized agencies—such as, but not limited to, the Food and Agriculture Organization; International Fund for Agricultural Development; World Food Programme; international, regional, and national agricultural research institutions; civil society organizations; and the private sector.
- 3) Continue to align fisheries's operations in coastal and rural development with greater focus and selectivity to support and enhance the impacts in core areas of operations to food security.
- 4) Increase support for fisheries and marine resources research with a focus on the specific and prioritized needs of Western and eastern Indonesia, through a programmatic approach over a longer-term research duration.
- 5) Invest in collaborative learning and knowledge development for sustainable food security through the strengthening of the community of practice (CoP) on fisheries and food security, inter-CoP networking, and collaborative work with the external partners.
- 6) As the future climate unfolds, more will be needed. Our natural system face a race against time. Over the coming years, we all may committed to pushing the boundaries of science in the search for ways to stay ahead of climate change. The future of our natural system may depend on these efforts.



**Figure 1.** Three Dimensions of Sustainable Food Security.

Source: FAO, 2015.

#### 4. CONCLUSIONS

Adapting to climate change will ultimately require more systematic integration of governance strategies, science, regulatory systems, policy, and economics at an international level to deal effectively with the wide range of impacts projected for Indonesia. This integration will be shaped through formal mechanisms such as the development or modification of laws, regulations, and policies. Integration will evolve through more subtle changes in institutional culture, channels of communication, and modes of interaction that build trust among Governments, Government agencies and stakeholders.

The current paper has discussed fundamental concepts of planning for climate change and has identified options for adapting to the impacts evaluated. However, the report should not be viewed as an end to the discussion on adaptation needs. That discussion is, in fact, just beginning. Areas of future research to support adaptive planning include research on institutional capacity needs and on regulatory barriers to adaptation. Improving institutional capacity to understand and better incorporate climate change impacts into planning is a “no regrets” strategy that would yield benefits regardless. The recurring need for updated information on climate impacts and other related information places a heavier reliance on the use of data collecting agencies and the best available science in the policies used to govern human and natural systems.

#### ACKNOWLEDGMENT

The author wish to thank Faculty of Fishery and Marine Science, Universitas Padjadjaran which support the study through Research Joint Program

#### References

- [1] Cao, L. China’s aquaculture and the world’s wild fisheries. *Science* 347 (2015) 133–135.
- [2] Cheung WWL, Watson R, Pauly D. Signature of ocean warming in global fisheries catch. *Nature*, 497 (2013) 365–368.
- [3] FAO. in Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication xiip 18 (Food and Agriculture Organization of the United Nations, 2015).
- [4] Garibaldi, L. The FAO global capture production database: a six-decade effort to catch the trend. *Marine Policy* 36 (2012) 760–768.
- [5] Harper, S., Zeller, D., Hauzer, M., Sumaila, U. R. & Pauly, D. Women and fisheries: contribution to food security and local economies. *Marine Policy* 39 (2013) 56–63.
- [6] Pauly, D. & Charles, T. Counting on small-scale fisheries. *Science* 347 (2015) 242–243.
- [7] Pauly, D. & Froese, R. Comments on FAO’s State of Fisheries and Aquaculture, or ‘Sofia 2010’. *Marine Policy* 36 (2012) 746–752.

- [8] Rizal A. (a). Reformulation of Regional Development Strategy to Strengthen Marine Sector in West Java, Indonesia. *World Scientific News* 107 (2018) 207-215.
- [9] Rizal A. (b). Science and policy in the coastal zone management. *World News of Natural Sciences* 21 (2018) 1-8.
- [10] Rizal A, Suryana AAH, Herawati H, Lantun PD, Izza MA, Regional Perspective To Build Competitiveness For Indonesian Fishery Sector In The Global And Autonomy Regime. *Int. J. Agric. Env. Res.* Vol 3 (6) (2017) 4368-4388.
- [11] Rizal A. & Nurruhwati I, Contribution of Human and Capital Toward Regional Economic Growth of Garut District of West Java Province of Indonesia. *Global Scientific Journal* 6 (5) (2018) 172-179.
- [12] Rizal A & Nurruhwati I. New Methodological Approaches for Change in Traditional Sectors: The Case of the West Java Fisheries Socio Economic System. *World News of Natural Sciences* 22 (2019) 41-51.
- [13] Rizal A., Herawati H, Zidni I, Apriliani IM, Ismail MR. The role of marine sector optimization strategy in the stabilisation of Indonesian economy. *World Scientific News* 102 (2018) 146-157.
- [14] Rizal A., Sahidin A., Herawati H. Economic Value Estimation of Mangrove Ecosystems in Indonesia. *Biodiversity* 2 (1) (2018)123-126.
- [15] Zeller, D., Harper, S., Zyllich, K. & Pauly, D. Synthesis of under-reported small-scale fisheries catch in Pacific-island waters. *Coral Reefs* 34 (2015) 25–39.