A Blue Economy Lesson from Cirata, Indonesia

Atikah Nurhayati[*], Titin Herawati, Isni Nurruhwati

Faculty of Fisheries and Marine Science Padjadjaran University, Indonesia
*Corresponding author: atikah.nurhayati@unpad.ac.id; nurhayati_atikah@yahoo.com

Abstract Cirata is a fertile body of water covering an area of 6,200 Ha. It represents an important source of subsistent living households in the Cianjur District of West Java Province for generations. This body of water, however, is undergoing an alarming rate degradation, which threatens not only the life of the subsistent households but also the future of other potential services. The increasingly dominating role of external landlords and the overuse of fish feed in aquaculture in the water are the main cause of the problems. Efforts which adopt the principles of blue economy were then placed to save the lost potential benefits. These include empowering local people to improve their economic performance and bargaining power, development of local-material-based organic feed. Feed were formulated from an aquatic plant water hyacinth locally called *enceng gondok*; the choice over this plant was at the outset targeted two objectives: (1) to provide cheap raw material for feed formulation, and (2) to increase water area available for aquaculture. Local people were trained to formulate the feed and operate their own aquaculture cages. The results show that: (1) local people were increasingly able to improve their economic performance, (2) areal coverage available for aquaculture got wider, (3) the use of environmentally friendly feed increased. The project has been going on for only four years, but the outcome shows strong indications that the project's approaches can be continually implemented and adopted elsewhere. This paper, however, suggests an implication which has to be taken care of by the government, wherein a complementing local government policy is needed to support such a project with a relevant effective regulation.

Keywords: blue economy, cirata, Eichhornia crassipes, fish feed, zero waste

1. Introduction

Fisheries sector is a sector that is instrumental in the economic development of Indonesia. Among the country's fishery production centers is the floating net cage aquaculture of Cirata Reservoir. Aquaculture in Cirata represents one of the reservoir's several functions which also include power generation for Java and Bali, public water transportation pathways, and recreational destination. Problems arise currently due to very unstoppable rapidly growing number of floating net cages, which in turns creates a common property and open access situation.

Management of Cirata Reservoir is not independent of the local government, whch is the main stakeholder in the use of Cirata Reservoir. Unfortuately, local government has so far not played the role as expected. Inconsistency of the Government West Java Province in the use Cirata Reservoir as public waters is detected, for example in term of the issuance of aquaculture permits that is not based on aquaculture map, supposedly an important part in supporting the sustainability of aquaculture in Cirata Reservoir. (Nurhayati, 2015) [1].

Restrictions on the number of units of floating net cages in Cirata was not imposed and carrying capacity was exceeded. Given this, a re-ordering through controlled management system becomes urgent and relevant such that both ecological and economical goals can be accomplished. Theoretically, the capacity for ideal floating net cages is 12,000 units, but in 2013 54,000 units were already recorded (BPWC, 2014) [2] an. Problems capitalized as the local government practices did not treat users equally. (Nurhayati, 2013) [3].

In addition to problems related to over capacity, there is another caused by the growth of hyacinth, triggered by excessive waste production in the reservoir. The unused aquaculture feed is wasted and became available for for the growth of water hyacinth. The growth of water hyacinth resulted in the decrease of water quality and this becomes a problem for aquaculture production activities floating net cages. This provides a justification for a research the utilization of water hyacinth for commercial products. Such research can also be expected to open opportunities to improve water quality and hence increase aquaculture production. It is worth noting here that utilization of of the reservoir function cannot be separated from the economic value for stakeholders that utilizes Cirata Reservoir; therefore, any attempt in the reservoir management should be directed not only for the sake of environmental purposes, but should also deals with economic interests. Utilization of water hyacinth into derived products that have economic and social value is the optimal utilization of water hyacinth, so that water

hyacinth is no longer a threat to the survival function Cirata Reservoir as power generation, transportation public waters, and recreation areas.

Blue economy approach can be considered as a good approach to deal with the problems mentioned above. The approach can be used as the basis of resources management of aquaculture in Cirata, wherein economic and social, ecology, technology, and local govermment regulations can be optimized to support the sustainability of Cirata reservoir floating net cage aquaculture [4]. Following from Pauli (2006), the blue economy approach to be implemented will promote innovations for practical solutions based on sustainable natural systems [5].

The approach also will follow the (UNEP 2013) [6], which strives for: "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities".

2. Material and Methods

The method used in this research is survey method. Survey method is observation or investigation is critical to get a good description, to a specific problem in a specific area or location. Multivariate analysis is an analysis of variance, multiple dependent variables by one or more factor variables or covariates. The data used are primary and secondary data. The data used for the dependent variable are quantitative. The variable factors using categorical data.

The dependent variable is an economic and social value, whereas the variable of factor is the level of application of the principle of blue economy. Multivariate Analysis is intended to determine the effect of the application of economic principles to the economic and social value. The test used is the homogeneity assumption test, multivariate testing and hypothesis test.

Tests on the economic value, Ho: there is no difference between the level of economic value applying the principle of blue economy inferior, moderate and superior, Ha: There is a difference between the level of economic value applying the principle of blue economy inferior, moderate and superior. Determining the value of the probability of the tables Test of Between Subject Effects decision-making probability > 0.05 so Ho accepted and probability ≤ 0.05 so Ho rejected.

Tests on the social value, Ho: there is no difference between the level of social value applying the principle of of blue economy inferior, moderate and superior, Ha: There is a difference between the level of social value applying the principle of of blue economy inferior, moderate and superior. Determining the value of the probability of the tables Test of Between Subject Effects decision-making probability > 0.05 so Ho: accepted and probability ≤ 0.05 so Ho rejected.

Table 1. Level of Principles Blue Economy

No	Level of Principles Blue Economy	Economic Value	Social Value
1	Superior (Enviromental and Ecological Suitability, Food Security, Energy Renewable, Zero Waste, Human Well Being, Social Equity)	7-9	7-9
2	Moderate (Food Security, Enviromental and Ecological Suitability)	4-6	4-6
3	Inferior (Food Security)	1-3	1-3

3. Results and Discussion

Cirata is one reservoir built in the Watershed (DAS) Citarum which was built in 1987. This reservoir was built at an altitude of 221 m above sea level, has a catchment area 603 200 ha, the average depth of 34.9 m and a volume of 2,165 x 106 m^3 [4]. Cirata included in the body of water that has a primary function as a power plant with a power of 500 MW [1].

Cirata included in the body of water that has a primary function as a power plant with a power of 500 MW [1]. Floating net cages, fish farming activities in Cirata, average production is 6,450 tons of fish / month, the amount floating net cages by more than 50,000 units. Based on studied the impact of sea cages in Sweden, found a strong correlation between input load of fish and rate, solubility of nutrients, especially between the load input total Nitrogen and Fosfor of aquaculture the concentration in the waters [2].

Floating net cages cultivation of waste into the environment will effect on the reduction of oxygen dissolved, eutrophication and changes in structure community [7]. Floating net cages in Cirata has a surface area per needs plots $7x7m^2$ and its depth varies between 2-3 m, usually farmers using 4 plots or equal to 1 unit for fish farming [4].

Floating net cages used are usually composed of two layers of mesh, the first layer consists of four nets the size 7x7x2,5 or 3x3x3 m^3 commonly used to preserve goldfish and the second layer is 1 m^3 15,8x15,8x5 nets the size commonly used to preserve tilapia fish. The nets used are made of materials, polyethylene (PE) D.18 with a mesh size (mesh width) between 0.75-1 mm [5].

Management of fishery resources aims to meet the current and future human needs in the fulfillment of fishery resources without destroying the marine ecosystem [13]. Fisheries management has been defined as the practice of analyzing and selecting options to maintain or alter the structure, dynamics, and interaction of habitat, aquatic biota, and man to achieve human [6]. Fisheries aims to meet human needs without damaging the fisheries resources for generations to come. One forum multilateral economic cooperation, this could be an occasion to make an Asia Pacific Economic Conference (APEC) as one of the instruments implementing economic diplomacy with blue economy models to achieve partnership among APEC members in the field of marine and fisheries with the concept of sustainable development. APEC itself defines blue economy as an economic model that encourages the implementation of sustainable development. The economic model to develop industrialization of marine and fisheries emphasis on growth, job creation, and encourage innovation of environmentally friendly technologies.

Blue economy was first introduced by Gunter Pauli, founder and activist Reasrch Zero Emission Initiative

(ZERI) through his book entitled 'The Blue Economy' with a foundation of conception 'The blue economy: 10 years, 100 innovations, and 100 million jobs'. Model blue economy was meant to show the entrepreunship, that the blue economy to give business model to develop investment opportunities and a more profitable business in the economic, social and environment for system environment, production systems more efficient and cleaner, producing greater economic product, increase the absorption of power work, and provide an opportunity to provide benefits to each contributor to more equitably.

By Gunter Pauli Blue economy means "Ocean blue – blue sky", it is understood that this model approach blue economy will be able to generate economic growth and prosperity the people, but the sea and the sky remained blue [12]. Definition of blue economy also delivered by Tridoyo Kusumantato [14] the seminar blue economy in 2012 in Bogor, namely blue economy can be expressed as economic activity in coastal and sea-supported activities the mainland's economic welfare of society as well as can take place an ongoing basis. The principles of economic efficiency of blue are natural in a sense, the blue economy modeled on nature ecosystems, working in accordance with what nature provides with efficient and does not reduce but it enriches the natural (shifting from scarcity to abundance and zero waste, waste from the one being the food / energy source to another, so the system life in ecosystems balanced, distributed energy efficiently and evenly without external energy extraction, work towards higher levels of efficiency to drain nutrient and energy without leaving waste to leverage capabilities whole contributor and meet the basic needs of all.

The number of respondents who successfully interviewed as many as 60 respondents consisting of floating net cages fish farmers and other stakeholder. Reliability tests performed to analyze the data of respondents. Based on the known value of Cronbach alpha 98.4 reliability test data used by means reliable. Based on multivariate analysis of covariance test values obtained are intended to test the similarity of the covariance of the data group is used. From the output can be seen in Table Box's Test of Equality of Covariance Matrices.

Table 2. Box's Test of Equality of Covariance Matrices(a)

Box's M	10.927
F	1.586
df1	6
df2	981.171
Sig.	.148

Table 2 Box's Test of Equality of Covariance Matrices is known that the significance is 0.148, it can be concluded that the covariance of the data is the same, so the assumption of homogeneity has been fulfilled. Homogeneity assumption test using the equality test of variance (Levene's test)

Table 3. Levene's Test of Equality of Error Variances(a)

	F	df1	df2	Sig.
Economic	.454	2	57	.638
Social	.964	2	57	.387

Homogeneity assumption test using the equality test of variance (Levene's test) Given that the significance of the variables is the economic value and social value 0.387 and 0.638 means the assumption of homogeneity has been fulfilled.

Multivariate testing to determine whether there was an effect whether or not the principles of the Blue Economy on the economic value and social value of the test consists of Pillai's Trace, Wilk's lambda, Hotelling's Trace and Roys Largest Root. The criteria used Multivariate Tests of the table can be seen that the significance <0.05, it can be concluded that there is influence between the principle of blue economy towards economic and social value, from tables Multivariate Tests.

Hypothesis test used to determine whether there is economic and social value difference between the level of application of the principle of blue economic blue inferior, moderate and superior. In interviews with the respondents' level of implementation of the principle of blue economic superior (Environmental and Ecological Suitability, Food Security, Energy Renewable, Zero Waste, Human well Being, Social Equity), moderate (Food Security, Environmental and Ecological Suitability), inferior (Food Security), tests on the economic value, where Ho: there is no difference between the level of economic value the application of principles of blue economic inferior, moderate and superior, while Ha: there is a difference between the level of the economic value of applying the principle of blue economy inferior, moderate and superior. Determining the value of the probability of the table Between Subject Test of Effects on decision-making in which the probability > 0.05 so Ho accepted and the probability of ≤ 0.05 so Ho rejected. Conclusion: it is known that the probability (0.000) <0.05 so the null hypothesis is rejected, the conclusion that there is economic value between the level of application of the principle of blue economic, inferior, moderate and superior.

Table 4. Multivariate Tests(d)

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(a)
Intercept	Pillai's Trace	.997	8112.470(b)	2.000	56.000	.000	.997	16224.940	1.000
	Wilks' Lambda	.003	8112.470(b)	2.000	56.000	.000	.997	16224.940	1.000
	Hotelling's Trace	289.731	8112.470(b)	2.000	56.000	.000	.997	16224.940	1.000
	Roy's Largest Root	289.731	8112.470(b)	2.000	56.000	.000	.997	16224.940	1.000
Blue_economy	Pillai's Trace	1.019	29.586	4.000	114.000	.000	.509	118.345	1.000
	Wilks' Lambda	.011	240.501(b)	4.000	112.000	.000	.896	962.003	1.000
	Hotelling's Trace	88.235	1213.234	4.000	110.000	.000	.978	4852.937	1.000
	Roy's Largest Root	88.204	2513.825(c)	2.000	57.000	.000	.989	5027.649	1.000

a Computed using alpha = .05
b Exact statistic.

Tests on social values, determining the null hypothesis and the alternative hypothesis Ho: there is no difference between the application of the social value of the inferior level of blue economy, moderate and superior. Ha: There is a difference value between the level of application of the principle of social of blue economy inferior, moderate and superior. Determining the value of the probability of the table between subject test of effects on decision-making in which the probability > 0.05 so Ho accepted and Probability ≤ 0.05 so Ho rejected. Conclusion: it is known that the probability (0.000) <0.05 so the null hypothesis is rejected, the conclusion that there is a difference value between the level of application of the principle of social of blue economy inferior, moderate and superior.

Based on the results of field research and interviews with the respondents that the application of the principle of blue economy, can be divided into three levels inferior, moderate and superior. Each level has an influence on the economic value and social value of each respondent. Field conditions showed a lack of attention of the government in supporting the implementation of the principle of blue economy. The application of the principle of blue economy remains piecemeal by local people, is indispensable support and the government's role as a regulatory agency to apply the principle of blue economy in order to achieve the environmental and ecological suitability, food security, renewable energy, zero waste, well human being, social equity.

Floating net cage aquaculture as an economic activity has a very important role in the progress and prosperity of local communities, especially for communities affected by the construction in Cirata Reservoir for hydroelectric power generation that are expected to supplying electrical energy to Java and Bali in Indonesia. Derivative function of Cirata Reservoir such as public water transportation, recreation and aquaculture floating net cages. As an economic activity, aquaculture should continue to be promoted and developed as well as a priority in order to be able to produce positive regional economic growth.

This requires innovation and creativity and optimize the role of stakeholder, in this case the government to fishing activities still exist and can contribute to the welfare of local communities. The activity aquaculture floating net cages by cultivating major commodities, namely Cyprinus carp and other commodities, namely Oreochromis niloticus, Pangasius, Oxyeleotris marmormata. The process of aquaculture production requires production inputs such as seed quality fish, feed with higher protein to stimulate the growth of the fish, the water quality that is suitable for the growth of fish of all of production inputs, costs incurred most as much as 70% of the total cost of production is fed.

Feeding the fish is excessively common in floating net cages, fish farmers in public waters Cirata, it is because the feeding is done manually causing a lot of fish feed is wasted and settles in the open acess in Cirata Reservoir. This feed precipitate accelerates the process of growth of water hyacinth. Water hyacinth has become one of the wastes in Cirata Reservoir because it would interfere with the primary function Cirata Reservoir as Java- Bali electricity generation due to the deposition of sediment from feed residue and blooming water hyacinth would endanger turbine electricity generation.

Water hyacinth blooming conditions also influences the activity of public transportation, where the propeller the boat will be choked with water hyacinth so it can not play back properly. Besides, the condition of blooming water hyacinth also reduces the interest of the public for recreation in Cirata Reservoir, because public waters covered with water hyacinth, nor to aquaculture floating net cages blooming water hyacinth reduce fish growth because the sun is covered with water hyacinth and oxygen levels are increasingly decline will ease the fish disease. Conditions in the field where water hyacinth is a waste for the whole activity Cirata Reservoir function, necessitating the application of the principle of blue economy through several levels of inferior, moderate and high. Utilization of waste water hyacinth into products that have economic and social value being done by applying the principle of of blue economy.

Blue economy is a model of economic development approach that no longer relies on economic development based on the exploitation of natural resources and the environment are excessive, but it is a great leap in development, leaving economic practice that emphasizes short-term gains and move the economy of low-carbon (low carbon economy). Model blue economy approach is expected to answer the interdependence between the economy and the ecosystem as well as the negative impact of of blue economy activities, including climate change and global warming. The Blue economy as a new concept of development of marine and fisheries will be directed towards balanced economic development between the use of marine resources and fisheries management efforts optimal and sustainable environment.

Blue economy aims to boost economic growth through a variety of innovative and creative activities while ensuring the business continuity and environmental sustainability. The concept of blue economy forward and focus on efficiency. Efficiency encourages investment and business development while maintaining environmental, fisheries remain sustainable. Blue economy is a process where the raw materials, water hyacinth which is a waste of floating net cages, fish feed could be processed into fish feed for herbivorous fish, handicrafts and biobriket . Where the production process comes from the universe and to follow the way nature works. Blue Economy is a tool that can be used to improve the condition of today's economy becomes less good and create more activity in the form of Sustainable model. Blue Economy concept was developed to address the challenges of the world economic system that tends to exploitative and damaging the environment that are caused by the exploitation exceeds the capacity or carrying capacity of nature.

Aquaculture floating net cages with small scale, medium and large, the waste that pollutes the waters originating from organic material leftover fish feed, the use of drugs (chemotherapetic agent) to treat fish diseases to overcome this there are several technologies that use natural materials or bacteria probiotics to treat fish diseases and treatments as well as the application of technology of cultivation media IMTA (Integrated Multi level Trophik aquaculture) which makes the rest of the fish feed in a state of zero waste.

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┌─────────────────────────────────────────────────────┐
│ Cirata Reservoir (hydro power, tourism, transportations, │
│              floating net cages                       │
└─────────────────────────────────────────────────────┘
                          │
┌──────────────────────────────┐   ▼
│ Enviromental and ecological   │  ┌────────────────────────────────────────────┐
│         parameter             │  │ Floating net cages (Aquaculture) Cyprinus carpio, Oreochromis niloticus, │
└──────────────────────────────┘  │      Pangasius, Oxyeleotris marmormata      │
                                   └────────────────────────────────────────────┘
                                              │
                                    ┌─────────────────────┐
                                    │ Feedding Procesing  │        ┌──────────┐
                                    └─────────────────────┘        │ Problem  │
                                              ▼                    └──────────┘
                          ┌──────────────────────────────────────────────────┐
                          │ Blooming water hyacinth (Eichhornia crassipes)   │
                          └──────────────────────────────────────────────────┘
┌──────────────────────────────┐              │
│ Solution to extraction        │              ▼
│ Water hyacinth to make added  │  ┌──────────────────────────────────────────────────────────────┐
│ value                         │  │ The derivatives extraction water hyacinth to have economic and social value │
└──────────────────────────────┘  └──────────────────────────────────────────────────────────────┘
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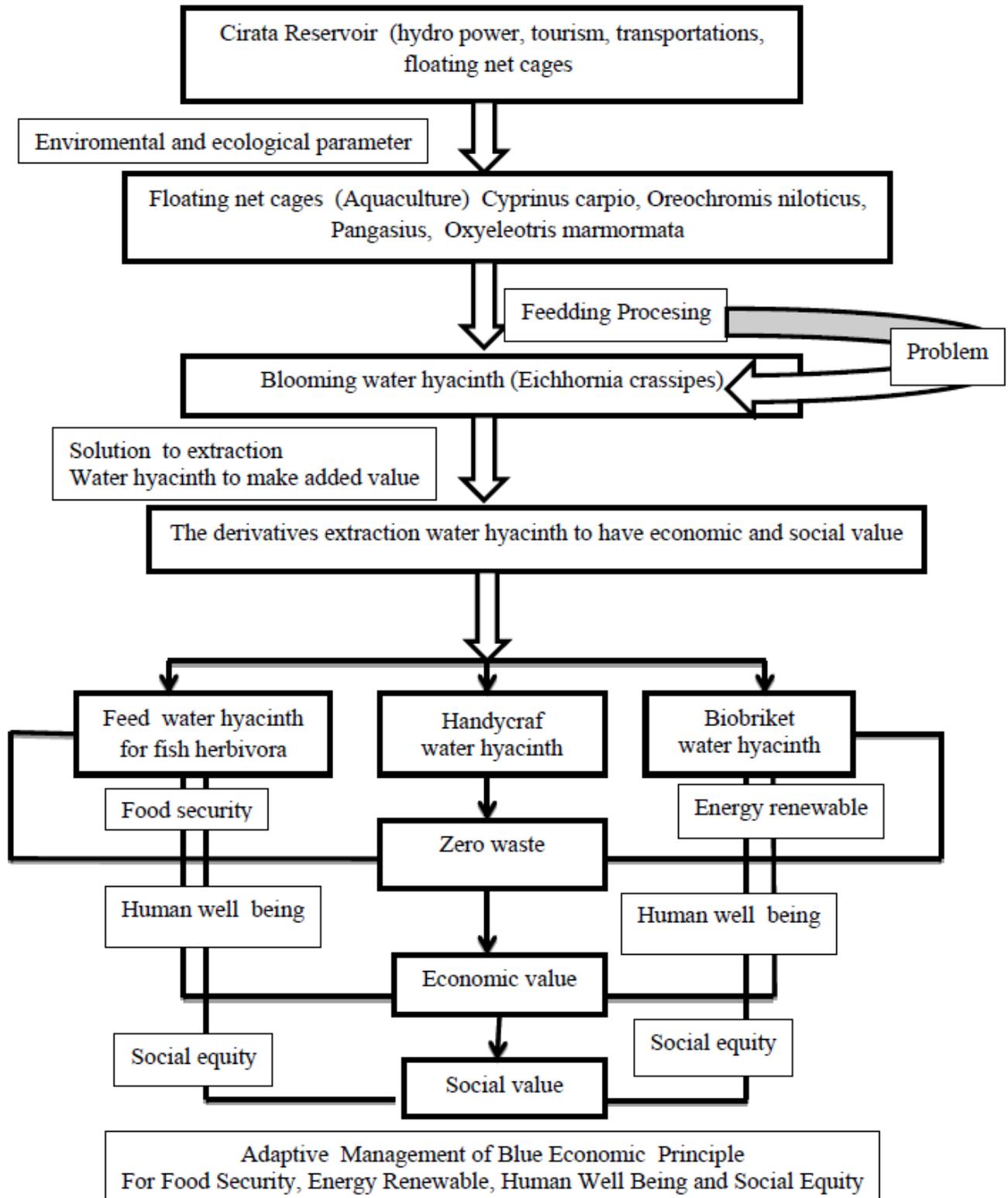
Figure 1.

The conditions apply principle blue economy (1) local people were increasingly able to improve their economic performance, (2) areal coverage available for aquaculture got wider, (3) the use of environmentally friendly feed increased. Application of the principle of blue economy is able to generating employment, increase individual productivity, improvement of living and life income, the addition of foreign exchange through activities.

Floating net cage aquaculture apply good practice fish system is a standard set of the fish farmers to ensure the cultivation process, the quality of farmed fish and the waste output of aquaculture activities must be in accordance with established standards. Internationally for fish farming activities, there are some standards set by international certification bodies, such as the certification body Global Aquaculture Alliance (GAA) which is the

standard set by the agency must be met if the farmed fish will be purchased by the consumer purposes. One of the important points that must be met is the output of waste from activities should not pollute the environment or alter and damage natural ecosystems.

Tests on social values, determining the null hypothesis and the alternative hypothesis Ho: there is no difference between the application of the social value of the inferior level of blue economy, moderate and superior. Ha: There is a difference value between the level of application of the principle of social of blue economy inferior, moderate and superior. Determining the value of the probability of the table between subject test of effects on decision-making in which the probability > 0.05 so Ho accepted and Probability ≤ 0.05 so Ho rejected. Conclusion: it is known that the probability $(0.000) < 0.05$ so the null hypothesis is rejected, the conclusion that there is a difference value between the level of application of the principle of social of blue economy inferior, moderate and superior.

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4. Conclusion and Recommendations

In principle, the blue economy can be implemented in public waters Cirata of economic activity aquaculture floating net cages. But aquaculture floating net cages generating residual waste feed, thereby increasing the productivity water hyacinth which is a waste, but by fish farmers could be utilized as a natural food, making of handicrafts and as an alternative energy biobriket that have economic and social value for local communities. Where in a complementing local government policy is needed to support such a project with a relevant effective regulation.

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