Livelihood analysis of floating net cages fish farmers at Sendang Village Sub-district of Gajah Mungkur Reservoir of Wonogiri Regency

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Abstract. Floating net cages farming (KJA) is one of the main livelihood resources in Sendang Village, Gajah Mungkur Reservoir. The purposes of this study were to determine the livelihood asset of fish farmers, the problems of livelihood asset management and the utilization strategy to support aquaculture businesses also farmers livelihood. The study showed that the natural capital, provides easiest way to farmer in fish cultivation. The fish farmers also have good technical capabilities in fish cultivation and the product has high demand and value which is essential for farmers livelihood. The main problems faced by small-scale farmers and all large-scale farmers were transition period, and the rise of cost price which sometime cause the failure in the business. The strategies to deal the problems include technological adjustment, managing the pattern of stocking of tilapia seeds and income source diversification. There were differences in dealing the rise of cost. The small-scale farmers borrow from the bank, while medium-scale farmers use their savings. Another difference of livelihood strategy was the management of financial capital. However, various strategies were still required to increase the livelihood of fish farmers and could address the vulnerabilities in the cultivation of KJA as a common pool resources.

1. Introduction
Global tilapia production is expected to almost double from 4.3 million tons to 7.3 million tons between 2010 and 2030, according to World Bank [1]. World tilapia production in 2015 is about 5,576,800 metric tons which has price about seven USD·kg⁻¹. China is world’s largest producer of tilapia farming and Indonesia’s tilapia production is in the second stage after China [2]. The development of tilapia farming provides benefits for rural communities in the form of job opportunities, sources of income and collective-based socio economic activities. The fisheries sub-sector in Wonogiri Regency has a positive growth rate. One of the factors were caused by the development of fish farming in the form of floating net cage farming (KJA) in Gajah Mungkur Reservoir.

Sendang Village, Sub district of Wonogiri, Wonogiri Regency is a village that directly adjacent to Gajah Mungkur Reservoir. Sendang Village is a fishery business center that has various potential such as processing and marketing fish, catching fish and cultivation fish in floating net cage farming (KJA). According to Department Animal Husbandry, Fishery and Maritime of Wonogiri Regency said that the cultivation fish in floating cage farming (KJA) with 176 units of KJA is able to produce an average of 900 tons of fish per year [3]. The tilapia cultivation pattern of KJA fish farmers is usually spreading 69.19 kg/plot tilapia seed in one period. The rotation take is about four months [4]. Tilapia cultivation
in KJA at Sendang Village has been growing for approximately 30 years. This of course have impact on ups and downs of the fish farmer’s number and other stakeholders of fisheries. The ups and downs of fish farmer’s number are caused by many factors, such as environmental factors. When the weather is deteriorating or the intensity of rainfall is high, that causes upwelling resulted in mass fish mortality. In addition, the ups and downs of the number of cultivators are influenced by the price of production factors such as dynamic of price like feed prices, seeds, scarcity of seed stock, highly dependence on factory feed, fluctuations in tilapia fish demand that seasonal also affect the sustainability of the business of tilapia fish farmers in Sendang Village District, Wonogiri.

One of the reasons fish farmers maintain in their business because high of demand of fish both from inside and outside the region. Demand of tilapia fish in local markets is quite a lot from the owners of restaurants that located in along the rim of the reservoir. Outside demand of tilapia fish came from Yogyakarta, Magelang and surrounding areas. The outside demand also included the export market. The strategy to optimize the potentiality of the region from each fish farmers is of course different. Differences of this strategy are influenced by differences in problems and challenges faced and the ability owned by each fish farmer household in managing their capital. Cultivation is very dependent on the availability of various capital or resources, including social capital, human capital, economic financial capital, natural resource and environment capital and physical capital (infrastructure) [5]. These capitals are often modified by the role of social relations (such as gender, economy class, age, ethnicity and religion/race), institutional influences (rules, customs, customs, markets) and vulnerabilities (such as natural disasters and conflicts, economic, fluctuating prices, population growth and population issues and changes in technology and macro policies) [5].

Department of Fishery make policy and strategy to develop the scale of micro and small business of fishery such as providing technical and managerial assistance to improve micro business to be feasible as well as bankable in long term and existence of financial guarantee system to operationalization of micro business activity [6]. The development of fish farming business in Sendang Village shows a good improvement in terms of production and number of fish farmers. The number of fish farmers is likely to increase. This is supporting by the easy access to the financial capital through the Bank with the KUR (People's Business Credit) with low interest rates.

The approach used in analyzing the strategies applied by the fish farmers to keep the business going is a Sustainable Livelihood Approach (SLA). Allison & Ellis argue that the concept of livelihood is able to reconcile important factors that affect the vulnerability (problem) and strength of individual or family survival strategies [7, 8]. Therefore, the sustainability livelihood approach is important to be studied in order to provide an overview of vulnerability or problems to the livelihood capital faced by cultivating in KJA at Sendang Village, Gajah Mungkur Reservoir along with ideas that can be attempted to overcome the vulnerability based on livelihood capital which are owned. Based on the identification of the problem, this study aims to determine livelihood assets owned by KJA fish farmers in Sendang Village, Wonogiri Regency, to identify their problems in the livelihood capital management and to understand livelihood strategy to support cultivation in fish cages farming.

2. Materials and Methods

2.1. Research framework
This research was conducted from April to May 2016 in Sendang Village, Wonogiri Sub-district, Wonogiri Regency. The basic method used in this research is descriptive method. The research framework depicts in figure 1.
2.2. Method of data collection
This study used random sampling method interviewing 35 fish farmers as respondents. The sampling was based on Wonogiri Fisheries Department data that had selected randomly. The selected respondents were fish farmers who agree to participate. The collected data consisted of primary and secondary data. Primary data were gathered by interviews, observation and documentation. The primary data such as of the identity of the fish farmers (i.e., the name, the age and their education level), availability and access to livelihood capital of KJA fish farmers and household activities of KJA fish farmers were collected. Also, secondary data were collected by exploring literature studies and collecting data that available in Sendang Village and Fisheries, Animal Husbandry and Maritime Department of Wonogiri Regency, such as village monographs.

2.3 Data analysis
Data were analyze based on the four important components that have been included in the questionnaire such as fish farmers profile, ownership and access to each capital (natural, physical, financial, human and social). Afterward, it was enriched by analyzing the problems or challenges and survival strategies which was applied by the fish farmers by utilizing their livelihood capital. The data result was presented as a descriptive statistic which is in the tabulation that has been averaged and grouped according to existing groups or levels following the final results obtained. Also, some photograph and proxy approach were used to support the results.

3. Results
Sendang Village is a village that has easier access to Gajah Mungkur Reservoir (fishery zonation) so that KJA’s business has been growing in Sendang Village. Sendang population dependency ratio is
51.70%, the dependency ratio showed that every 100-productive people (people who have a job) have the responsibility to 52 peoples who were not working or unproductive. It means that the dependents of the people who are categorized as productive to finance the lives of people who have not yet and not productive enough are low so that the economic condition of the villagers is good enough [9].

3.1. Profile of fish farmers

Based on the findings that presented in table 1, the majority of fish farmers in Sendang Village were majority male and categorized as a productive worker based on the age. The minimum age of fish farmers or the youngest fish farmers aged 21 years old. The average of the fish farmers age is about 36 years old farmers. The aquaculture business opportunity in Sendang Village could survive and be maximized because the fish farmers are in the productive age. This situation is indirectly indicated that the cultivation of tilapia floating net cage farming (KJA) in Sendang Village has been growing for 50 years. The level of education of fish farmers in Sendang Village is high with the percentage of the education level of 51.43% of farmers have completed high school.

PERMEN KP (Maritime and Fishery Ministry Regulation) No. 5 year 2009 states that the scale of business in the field of fish cultivation is determined by assets (capital, volume/area of business units), turnover (proceeds). Small-scale KJA farmers have two to 10 units of KJA with production 0–2 tons/harvest and the revenue per year reaches Rp. 60,000,000.- [10]. Medium scale KJA farmers have 10 to 20 units of KJA, with total production reaches more than 2 tons/harvest and annual revenue reaches Rp 250,000,000. In the table below is the ownership data of KJA plots of the Sendang fish farmers based on the total production (harvest) in one period (table 2).

| Parameters                          | Frequency | Percentage (%) |
|-------------------------------------|-----------|----------------|
| Sex of respondents                  |           |                |
| Male                                | 33        | 94             |
| Female                              | 2         | 6              |
| Education level                     |           |                |
| Primary School                      | 4         | 11.43          |
| Junior High School                  | 10        | 28.57          |
| Senior High School                  | 18        | 51.43          |
| Diploma/Bachelor Degree             | 3         | 8.57           |
| Age of Villagers (years)            |           |                |
| Less than 20                        | 0         | 0              |
| 21–30                               | 8         | 23             |
| 31–40                               | 22        | 63             |
| > 40                                | 5         | 14             |
| KJA Farming Experience (years)      |           |                |
| < 5                                 | 18        | 51.43          |
| 5–10                                | 13        | 37.14          |
| > 10                                | 4         | 11.43          |

| Total production (kg)               | Fish farmers (person) | Percentage (%) | Percentage (%) |
|-------------------------------------|-----------------------|----------------|----------------|
| Small Scale                         |                       |                |                |
| less than 500                       | 19                    | 54.29          |                |
| 500–1,000                           | 10                    | 28.57          | 91.43          |
| 1,000–1,500                         | 3                     | 8.57           |                |
| Medium Scale                        |                       |                |                |
| ≥ 2,000                             | 3                     | 8.57           | 8.57           |
| total                               | 35                    | 100            | 100            |

3.2. Analysis of the utilization of livelihood capital

The percentage of livelihood capital used to support the cultivation of KJA by KJA fish farmers in Sendang Village, Wonogiri Sub-district, Wonogiri Regency is presented in table 3. The utilization of livelihood capital was used to face the problems that occur in the management of KJA cultivation business. Based on table 3, there were some strategies which were applied by Sendang Village fish farmers. The most dominant livelihood capital which is utilized as a source of survival by KJA fish farmers in Sendang Village, both small and medium scale fish farmers is the natural capital by utilizing the waters of Gajah Mungkur, Wonogiri Reservoir.
Table 3. Utilization of livelihood capital by KJA fish farmers in Sendang Village.

| Type of Capital       | Number of respondent | % respondent | Number of respondent | % respondent |
|-----------------------|----------------------|--------------|----------------------|--------------|
| Natural Capital       |                      |              |                      |              |
| Reservoir (public waters) | 32                  | 100.00       | 3                    | 100.00       |
| Physical Capital      |                      |              |                      |              |
| Handphone             | 32                   | 100.00       | 3                    | 100.00       |
| Internet              | 10                   | 28.57        | 3                    | 100.00       |
| Motorcycle            | 32                   | 91.43        | 3                    | 100.00       |
| Pick Up               | 0                    | 0.00         | 2                    | 66.67        |
| Diesel machine        | 25                   | 71.43        | 3                    | 100.00       |
| Human Capital         |                      |              |                      |              |
| Skill in fisheries    | 32                   | 100.00       | 3                    | 100.00       |
| Fisheries illumination| 8                    | 22.86        | 1                    | 33.33        |
| Financial Capital     |                      |              |                      |              |
| Loan                  | 32                   | 91.43        | 1                    | 33.33        |
| Saving money          | 21                   | 60.00        | 3                    | 100.00       |
| Small scale business  | 6                    | 17.14        | 2                    | 66.67        |
| Social Capital        |                      |              |                      |              |
| Processing fish group | 10                   | 28.57        | 0                    | 0.00         |
| Fish farmers group    | 25                   | 71.43        | 2                    | 66.67        |

Based on the findings that can be seen in figure 3, natural and financial problems is an important issue among the farmers of KJA tilapia in Sendang Village. Natural problems or vulnerabilities that faced by KJA fish farmers in Sendang Village were the impacts of the transition period. The strategy that has been done was a strategy that leads to minimize the risks posed such as technological manipulation, the reducing capacity of several plots of KJA, arranging the pattern of stocking and diversification of job. Financial problems such as lousy harvest, reduced revenues, fluctuation of prices and macro policies (i.e., fuel prices) affect production factor prices (i.e., increase in feed prices, seeds and other operational costs).

Figure 2. Capital livelihood vulnerability intensity.

Most of all fish farmers have other jobs as alternatives income source. Below is the list of profession/job of the fish farmer in Sendang Village (figure 3). Based on figure 3, people in Sendang Village have the primary job as a fish farmer (77.14 %). Meanwhile, the remaining 22.86 % has
various other jobs (i.e., laborers/masons or bricklayer, farmers, headman of the village, fish sellers, middleman (fish seller), drivers of truck and boat driver for tourism). Respondents who have the primary job as a fish farmer, they provide plenty of time to manage their cultivation.

![Figure 3. Number of fish farmers by their job (livelihood).](image)

Based on (table 4), The small-scale fish farmer has vulnerability or problems in the utilization or management of physical capital, which is the possession of diesel machine and boats. However, the small-scale fish farmers face these vulnerabilities by utilizing the social capital they possess such as their presence and participation in groups. Fish farmer groups facilitate access to borrow supporting facilities for the cultivation. Fish farmers who have interest in following counseling/training were few. Fish farmers who want to learn about fish cultivation and have physical capital (internet, television or radio), they can access it from it. That is a fish farmer’s strategy when they didn’t follow the counseling/training/education from Wonogiri Fisheries Department.

4. Discussion
In general, the strategy undertaken by KJA tilapia fish farmers in Sendang Village was not significantly different from the strategy undertaken by KJA fishermen in Jatiluhur Reservoir in a study conducted by [11] and fish farmers in Klaten by [12]. The ability of the fish farmers manages or utilize assets owned which can be a supporting factor of livelihood [11]. Tilapia fish farmers in Sendang Village were divided into two groups: small and medium scale fish farmers. Each fish farmers certainly has a different strategy in capital utilization to deal with the problem. The research results by [12] that was done in 2013 divides the tilapia fish farmers into several groups ranging from micro, small, medium and large scale. In general, the strategies were undertaken by small-scale tilapia fish farmers in Janti, Ponggok, Nganjat and Sidowayah Klaten Villages are raising capital by applying for loans, utilizing groups to buy feed and access government aid. The strategy undertaken by middle-scale farmers is to make a concerted effort, adding business networks, marketing products out-of-town [12]. Comparing the results of [12] research, the strategy undertaken by the tilapia fish farmers in Sendang Village was reasonably similar. This tendency happens because of the rural life habit which tends to be homogenous. Other research also states that one of the characteristics of rural society is to have homogenous characteristics [13].
### Table 4. Vulnerability and strategy issue that done by fish farmers.

| Capital | Problem                  | % respondent | Strategy                   | % respondent | Problem                  | % respondent | Strategy                   | % respondent |
|---------|--------------------------|--------------|----------------------------|--------------|--------------------------|--------------|----------------------------|--------------|
|         | Small scale fish farmers |              |                            |              | Medium scale fish farmers |              |                            |              |
|         |                          |              | Watering by diesel machine | 100          |                          |              | Watering by diesel machine | 100          |
| Natural | Oxygen reduction         | 78.12        | Give up                    | 77.78        | Oxygen reduction         | 100          | Give up                    | 66.67        |
|         | Upwelling                | 56.25        | Do nothing                 | 22.22        | Upwelling                | 66.67        | Do nothing                 | 33.33        |
| Natural | Shallow water            | 21.21        | Emptying some plots of KJA | 100          |                          |              |                            |              |
|         | Bird pest                | 21.21        | Use bell                   | 100          |                          |              |                            |              |
| Physical| Don’t have boat          | 3.12         | Get a loan                 | 100          |                          |              |                            |              |
| Physical| Don’t have diesel machine| 21.87        | Get loan from fish farmer group | 100          |                          |              |                            |              |
|         | Hard to get seed         | 71.87        | Decrease of seed           | 100          | Hard to get seed         | 33.34        | Buy from other region      | 100          |
|         | Increase seed price      | 59.37        | Depend on group            | 71.43        | Increase seed price      | 33.33        | Buy directly from feed and seed agency | observation |
|         |                          |              | Get a debt (transfer nota) | 100          |                          |              |                            |              |
| Financial| Low production           | 18.75        | Get a debt                 | 40.62        | Low production           | 33.33        | Diversification job       | 66.67        |
|         |                          |              | Diversification job       | 31.25        |                          |              | Arrange seed pattern      | 100          |
|         |                          |              | Arrange seed pattern      | 37.5         |                          |              |                            |              |
|         |                          |              | Fluctuation in demand market | 21.88    | Follow the low of market | observation | Fluctuation in demand market | 33.33    | Sell to outside market | 66.67 |
|         |                          |              |                            |              |                          |              |                            |              |
| Human   | Less interest in fisheries education/training | observation | Nothing strategy yet | - | Less interest in fisheries education/training | Observation | Learn from others sources | observation |
|         | Less in presence and being active in fish farmers group | observation | Do nothing | observation | - | Less in presence and being active in fish farmers group | Observation | Do nothing | observation |
| Social  | Price competition        | 25           | Do nothing                 | 100          | Price competition        | 33.34        | Sell to outside market     | 100          |
According to the data (table 2), the business opportunity of aquaculture in Sendang Village can be
developed and maximized because the fish farmers are in the productive age. The level of education of
fish farmers in Sendang Village is high which affects the ability of the fish farmers adapting and
receiving new knowledge or technology in the management of their aquaculture business. Formal
education is significantly related to the field of competence of farmers such as the marketing of
business results, harvest and postharvest handling. The situation reflects that the higher formal
education of the farmers, the higher level of competence they have [14]. It also said that diversification
strategies could develop optimally. It was determined by some factors such as household composition,
age and educational level of the farmer and his/her spouse. Moreover, the strength of social capital and
social networks, the ‘openness’ of the farmer towards outside world, the effort to looking for an
information and sources of knowledge and a professional attitude of the farmer are also key factors for
developing their farming [15]. The length of the fish farmers doing the cultivation of KJA in Sendang
Village is less than five years, indicated that all the growth in fish farms due to new entrants. Based on
the results of interviews, the increase of fish farmers number is triggered by the high opportunities for
the cultivation of KJA tilapia fish and easy access to get the bank loan. The success of fish farmers in
the cultivation business is closely related to the competence of agribusiness owned by fish farmers in
managing the fish farming business.

The average fish farmer does not have only one job or not just be a fish farmer, but also has
multiple jobs or other jobs to avoid unemployment. Participation of fish farmers and their wives in a
social group such as cultivation group and fish processing product group is a survival strategy that
they have been doing. Joining into fish processing product group were fish farmer’s wife strategy to
increase the added value and to fulfill the demand. This activity ensured the continuity of fish farming
business KJA in Sendang Village. These were a livelihood strategy that utilizes social capital or
connection among fish farmer’s wife. The access to credit is essential for small farmers.

Besides social capital, the access to credit is important for small farmers. The smaller fish farmers
prefer to get a loan from the bank while the medium scale fish farmer prefers to use their saving
money when they face challenges in finance. That is a reality or social facts that researcher found in
the field because the small-scale fish farmer who had not enough saving money. The easy access to get
a debt/loan from the bank was one factor that encourages small-scale farmers to get a loan from the
Bank. It was a rational action according to Weberian theory was an instrumentally rational action (an
action that taken consciously based on consideration and consciousness to reach the purpose of that
action and the means used to achieve the objectives). Considering the objectives to be achieved
(greater profits/maintaining business cultivation) and tools used to achieve goals (by borrowing from
the bank) [16]. Fishery Department of Wonogiri Regency has made policy and strategy to develop the
scale of micro and small business for fishery and aquaculture such as providing technical and
managerial assistance to improve micro business to be feasible for a long-term, and the existence of
financial guarantee system to the operationalization of micro business activity [6]. So that, they can
avoid the harvest failed. If it happened so, they would use their side-job to pay interest when there is a
severe harvest. It has been stated that the contribution of the new activities (off-farm) to the total
household income varies from a marginal to a substantial addition to the primary income, but,
whatever its size, this additional income can stabilize household finances, which would otherwise be
strongly influenced by price fluctuations and seasonal cycles. Off-farm employment can stabilize the
household finances, providing more than a quarter of household income systems [11].

5. Conclusion
The Gajah Mungkur Reservoir, the fish farmer ability, and the potential market were a basic capital
that had a vital role in maintaining fish cultivation business in KJA in Sendang Village especially to
perform survival strategy due to the disadvantages trends and shocks for Sendang Village fish farmers.
The main problem faced by 78.12 % of small-scale and all large-scale fish farmers was the seasonal
transition. Another problem was the increase in production factor prices (i.e., increase in feed prices,
seeds and other operational costs) (35.41 % of respondents). Capital utilization strategies conducted by
small and medium scale fish farmers were technological manipulation, arranging the pattern of stocking and having an alternatives job, especially when severe harvest. There was a difference in strategy when factor prices rise between small and medium-scale cultivators. Small-scale farmers chose to borrow from the Bank or have a loan, while medium-scale cultivators only use their savings. Another difference of livelihood strategy between small and medium scale fish farmers was the financial capital management which was exactly in time of hard to get tilapia seeds. Small-scale fish farmers typically reduce capacity/volume per plot while medium-scale fish farmers sufficient capital and networks can afford to buy from other regions.

References
[1] http://www.fao.org/docrep/019/i3640e/i3640e.pdf Accessed in 2017 October 30
[2] https://www.was.org/documents/MeetingPresentations/AQ2016/AQ2016_0005.pdf Accessed in 2017 October 30
[3] Department of Animal Husbandry Fisheries and Maritime Wonogiri Regency 2010 Fisheries Condition in Gajah Mungkur Reservoir (Wonogiri: Wonogiri Government Publishing)
[4] Ardi I 2013 Media Aquac 8(1) 24–25
[5] http://www.zef.de/module/register/media/2390_SL-Chapter1.pdf Accessed in 2016 October 3
[6] Department of Fisheries and Marine 2016 Banking Credit Schemes for the Development of the Marine and Fisheries Business Sector. (Jakarta Government: Directorat General P2HP)
[7] Allison E H and F Ellis 2001 J Marine Policy 25 377–388
[8] Ellis F 1998 J. Development Studies 3(1) 1–38
[9] Sendang Headman 2015 Sendang Village Profile (Wonogiri: Wongiri Government Publishing)
[10] Ministry of Fisheries and Marine Regulation of Ministry of Fisheries and Maritime of Indonesia 05/MEN/2009 about Business Scale in Cultivation Fish Indonesia
[11] Purwandari M I N 2014 J. Solidarity 3(1) 56–62
[12] Febriana 2013 Thesis Universitas Gadjah Mada Yogyakarta
[13] Yuanita A 2015 Thesis Universitas Gadjah Mada Yogyakarta
[14] Manyamsari I and Mujiburrahmad 2014 J. Agrisep 15(2) 58–60
[15] Meert H, Huylenbroeck G V, Vernimmen T, Bourgeois M and Hecke E V 2005 J. Rural Studies 81–97
[16] Damsar and Indrayani 2016 Rural Sociology Introduction (Jakarta: Kencana)