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Research Article

Environmental Friendly Foods in the Cultivation of Floated-Net Cages at Tondano Lake in North Sulawesi Province

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Abstract: The cultivation of Indigo Fish (*Oreochromis niloticus*) in the floated-net cages is the activity using water body of Tondano Lake. However, it contributes to environmental pollution due to fish food-induced turbidity. Some portions of food are not used by the fish and only discharged to the waters. The objective of research is to analyze the kind and mechanism of environmental friendly feeding with laboratory experiment approach. The analysis is conducted over the nutrient in three types of general food used by the cultivator of Indigo Fish (*Oreochromis niloticus*) in the floated-net cages along the coasts of Tondano Lake in North Sulawesi Province. The kinds of general foods observed are Food A (Nitrogen 4.62 %, Phosphorus 1.62 %), Food B (Nitrogen 4.75 %, Phosphorus 1.27 %) and Food C (Nitrogen 4.48 %, Phosphorus 1.28 %) at dose 3 % of body weight per day. Food A, Food B, and Food C are not physically different. The laboratory experiment shows that the dissolvability rates of Food B and Food C are lower than Food A. Remnants of Food B and Food C settled on the base of aquarium are still intact. It does not influence or change water quality. Food A settled on aquarium base leaves white grains. Result of experiment indeed shows that physical quality of water for the cultivation of Indigo Fish (*Oreochromis niloticus*) fed with Food A is more turbid than those with Food B and Food C. Other difference is also found on the feces released by Indigo Fish (*Oreochromis niloticus*). Fishes fed with Food A have their feces colored white, while those fed with Food B and Food C have their feces in similar color to food color. Results of laboratory analysis at Balai Riset Standarisasi Industri Manado (BARISTAND) indicate that nitrogen rate in the feces of Indigo Fish (*Oreochromis niloticus*) fed with Food A is higher (0.48 %) than those fed with Food B (0.21 %) and Food C (0.53%). High nitrogen rate in the feces of fishes feed with Food A (0.48 %) means that this Food contributes to the fertility of waters. Result of analysis also indicates that Food B and Food C are more environmental friendly to Tondano Lake environment. The frequency of feeding in the floated-net cages is three times a day which aims to prevent the heavy discharge of foods into the lake. Three-times-a day feeding frequency indeed is also used to anticipate the level of food discharge into Tondano Lake. Environmental friendly methods of feeding in the floated-net cages include surface net and submerged net. Those methods alleviate the input of organic wastes into Tondano Lake such that it can minimize the pollution in Tondano Lake.
Keywords: Food, Culture, Floated-Net Cages

INTRODUCTION

The cultivation of fishes in the floated-net cages is a cultural technology which optimizes the utilization of lake waters. Such cultivation in Tondano Lake grows dramatically and it gives negative impact on water environment. Not all foods are consumed effectively by fishes. Any remnants will increase nitrogen rate of waters due to the decomposition of protein in the pellet which may add nitrogen and phosphor rates in the sediment of waters [1].

Negative impact may be related to the reduction of water quality because of the decomposition of the accumulated food remnants which not used and the excretion of feces from fishes. However, waste discharges from the activity of floated-net cages will contribute lake fertility or lake enrichment (with nutrient) but also trigger the blooming of water plant such as Eceng gondok (*Eichhornia crassipes*) [2].

Some results of examination about water quality and fish foods in lake waters are helpful to develop the understanding about water quality and feeding mechanism in lake waters. According to Rachmansyah [9], food discharge into waters reaches 30 %. Ad-libitum (continuous) feeding until satiation may produce higher level of food discharge. Such feeding is not effective and efficient because it influences the quality of lake waters.

Phillips MJ *et al*. [3] and Mc. Donald ME *et al*. [4] declare that the discharged food remains in the range of 30 % and also between 25 and 30% as expressed feces. Unconsumed foods and fish feces contribute to the nutrient of lake waters but it also increases nitrogen and phosphor rates. Heavy organic waste due to ineffective and inefficient feeding may produce eutrophication and sedimentation [5].

The fertility of waters improves with the increase of nutrient as measured by the parameters of nitrogen and phosphor. Tondano Lake waters experiences eutrophication as shown by the blooming of Eceng gondok (*Eichhornia crassipes*) and the reduction of water quality due to mass death of the fish. Main parameters that cause eutrophication are the reduction of dissolved oxygen and the increase of nutrient from fish foods [6].

Such condition only accelerates the distortion of the imbalance at lake nature. Also, this phenomenon describes the relationship between water fertility (eutrophication), water quality and sedimentation. Feeding has been conducted and not all foods are consumed by fishes. Metabolism product of fishes, which is discharged as feces, represents only the waste for Tondano Lake because it contains nitrogen and phosphor although it improves the fertility of Tondano Lake.

METHODOLOGY

Research methods are descriptive exploration and laboratory test (experiment and analysis). These methods are selected based on the expected goals and the conditions of the field as the target of research. Descriptive exploration method is used to obtain the information of types and mechanisms of fish feeding in the floated-net cages operated in Tondano Lake.

Data collected for laboratory experiment involves 2 sources, which are secondary and primary data. Secondary data include 3 items such as food type, feeding method, and frequency and intensity of food in the cultivation of Indigo Fish (*Oreochromis niloticus*) in the floated-net cages along the coasts of Tondano Lake. Secondary data is the supplement to primary data. Primary data are obtained from the observation over the cultivation of Indigo Fish (*Oreochromis niloticus*) in the aquarium at The Laboratory of Food and Nutrient, Faculty of Fishery and Marine Sciences in UNSRAT. During laboratory experiment, feces of Indigo Fish (*Oreochromis niloticus*) are collected using the feces collecting devices.

Feces are collected every day and the demand is for 20 g fish feces. The method of collecting feces of Indigo Fish (*Oreochromis niloticus*) is explained as follows. Every aquarium in the size 60 x 40 x 40 cm is given 10 fishes with each weighted to 100 g. Before feces are collected, Indigo Fish (*Oreochromis niloticus*) is acclimated for 2 weeks to the situations of feeding and environment. Fishes are reared in different aquarium and fed with different foods. Feeding dose is 3 % of body weight/day at frequency of 3 times a day. After acclimatization (2 weeks), fishes are fed. After 2 hours, aquarium base is cleaned from the remnants of foods unconsumed by fishes. Feces are collected by using water pump that automatically inhales feces into feces collector. Feces collecting devices are designed by Tokyo University Fisheris [7]. Time needed from acclimatization until the collection of 20 g feces is 45 days. Everyday, the collected feces are packaged into aluminium foil and stored into refrigerator. These 20 g feces are then brought into the Laboratory of Balai Riset Standarisasi Manado (BARISTAND) to analyze nitrogen and phosphor rates.

Data Analysis

Proximate test is conducted over 3 food types (A, B, and C) that usually used by the cultivator of floated-net cages. Nitrogen and phosphor rates in the fish feces are also examined. Low nitrogen rate in feces will characterize environmental friendly food. Feeding method and feeding frequency are understood from the observation and interview in research location.

RESULTS AND DISCUSSION

Tondano Lake has 25 Villages and 4 Subdictricts along the coasts of the Lake. Total of floated-net cages installed for the cultivation of Indigo Fish (*Oreochromis niloticus*) include 7383 growth units and 3491 seedling units. There are 10,874 cage units installed in 14 villages, such as Touliang Oki, Ranomerut, Tandengan, Tandengan 1, Eris, Watumea, Telap, Toulimembet, Kaweng, Paslaten, Tounelet, Sendangan, Talikuran, and Urongo.

Table 1: Floated-Net Cage Units in Year 2014

Sl. No.	Village	Fish
1.	Touliang oki	203
2.	Ranomerut	175
3.	Tandengan	463
4.	Tandengan 1	282
5.	Eris	3756
6.	Watumea	966
7.	Telap	1157
8.	Toulimembet	2071
9.	Kaweng	280
10.	Paslaten	388
11.	Tounelet	507
12.	Sendangan	43
13	Talikuran	338
14	Urongo	245
	Total	10.874

Source: Results of Analysis in 2014

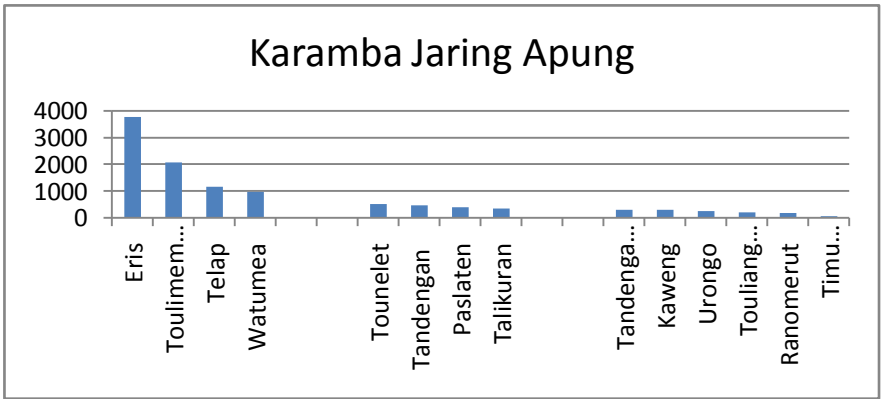

Fig. 1: The Grouping of Floated-Net Cage Units (High, Medium and Low)
Source: Results of Analysis in Year 2014

Table 2: The Composition of Food A, B and C Given to Indigo Fish (*Oreochromis niloticus*)

Sl. No.	Parameters	Result of Analysis			Percentage (%)	Method
		A	B	C		
1.	Water Content	9.67	10.31	10.47	%	Oven
2.	Ash Content	9.18	10.00	7.74	%	Gravimetric
3.	Crude Fiber	3.16	6.68	4.76	%	Gravimetric
4.	Lipid	6.43	7.05	7.47	%	Extraction
5.	Protein	28.86	29.69	27.98	%	Macrokjeldahl
6.	Carbohydrate	42.70	36.27	41.51	%	Calculation
7.	Nitrogen	4.62	4.75	4.48	%	Macrokjeldahl
8.	Phosphor	1.62	1.27	1.28	%	Spectrophotometer

Source: Results of Analysis, Proximate Test (2014)

Table 3: Result of analysis over nitrogen and phosphor in feces of fishes fed with 3 different types of food

Sl. No.	Food Type	Nitrogen (%)	Phosphorus (%)
1.	A	0.48	0.67
2.	B	0.21	0.67
3.	C	0.35	0.53

Source: Results of Analysis, 2014

Fig. 2: Feeding Method by Submerged Net

Fig. 3: Feeding Method by Surface Net
Sources: Documentations of Feeding at Eris Village, Eris Sub district

DISCUSSION

The cultivation of Indigo Fish (*Oreochromis niloticus*) in the floated-net cages has operated along the coasts of Tondano Lake. It is distributed throughout 14 villages by total of 10.874 units (Table 1). The grouping of floated-net cage units has divided the units into 3 levels, such as high levels (Eris, Toulimembet, Telap, and Watumea), medium level (Tounelet, Tandengan, Paslaten, and Talikuran) and low level (Tandengan 1, Kaweng, Urongo, Touliang Oki, Ranomerut, and Timu sendangan) (Fig. 1).

A method to economize the cost of intensive fish cultivation is by the efficient use of fish food to produce the fish with optimum growth and to minimize the food discharge. The feeding of artificial foods in the intensive cultivation is a factor supporting the production. The existing natural food may disable to meet the demand for fish demand. Fish demand for foods during rearing and growth is met by artificial foods that satisfy the demand for nutrient, digestion and appetite [8].

Results of proximate test for Food A, Food B and Food C given to Indigo Fish (*Oreochromis niloticus*) have shown different composition of nutrient and protein between Food A (28.86 %), Food B (29.69 %), and Food C (27.98 %). Nitrogen rate also differs between Food A (4.62 %), Food B (4.75 %) and Food C (4.48 %). Phosphor rate is also divergent among Food A (1.62 %), Food B (1.27 %) and Food C (1.28 %) (Table 2). As shown by the results of proximate test over protein percentage compared to Food A, Food B and Food C, the phosphor of Food A is higher than Food B and Food C.

Results of the experiment have shown that the physical quality of waters for the rearing of Indigo Fish (*Oreochromis niloticus*) fed with Food A is more turbid than that given with Food B and Food C. Results of laboratory analysis at Balai Riset Standarisasi Industri Manado (BARISTAND) indicate that nitrogen rate in the feces of Indigo Fish (*Oreochromis niloticus*) fed with Food A is higher (0.48 %) than those fed with Food B (0.21 %) and Food C (0.53%). High nitrogen rate in the feces of fishes feed with Food A (0.48 %) (Tabel 3) means that this Food has negative impact on the environment of Tondano Lake.

There are 3 feeding methods used for the fish cultivation in the floated-net cages, such as (a) Surface spreading, (b) Surface net, and (c) Submerged net (Fig. 2 and Fig. 3). Three methods are applied at Eris Village in Eris Subdistrict, but other villages use the methods of surface spread and do not use net. The unfavorable consequence of feeding method of surface spread is that many portions of foods are not consumed by Indigo Fish (*Oreochromis niloticus*), while that of feeding methods of surface net and submerged net is that foods may adhere onto the net. The later two are feeding methods used for the seeds of Indigo Fish (*Oreochromis niloticus*). These are also used to minimize the input of organic waste into Tondano Lake such that it will minimize the pollution at Tondano Lake.

CONCLUSION

The The foods must be environmental friendly. It means that foods must provide small impact on tiny environment. Production rate shall be not first priority if it only destroys environmental quality. The best feeding mechanism is ordered as follows: (a) Food B (with phosphor in food for 1.27 %, nitrogen in feces for 0.21 %, phosphor in feces for 0.67 %) and Food C (phosphorus in food for 1.28 %, nitrogen in feces for 0.35 %, phosphor in feces for 0.53 %); (b) Feeding methods by using surface net and submerged net are useful to reduce organic wastes incoming into Tondano Lake such that it will minimize the pollution at Tondano

Lake; and (c) Good feeding is 3 % from body weight per day and given 3 times a day.

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