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Original Research Article

Utilization of Sludge from Cow Dung Biogas as Additional Feed for Sangkuriang Catfish (*Claries gariepinus*)

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Abstract

Catfish farming is often faced with the availability of feed which is relatively expensive, so it is necessary to find a solution to support the catfish farming business—provision of sufficient and good quality feed to support fish growth. This study aimed to determine the level of sludge suitable for use as additional feed. Observations were made using the experimental method with a Randomized Block Design (RBD) research design involving one control group and three treatment groups with three repetitions each. The parameters observed were length (p), width (l), and fish weight (b). The environmental parameters observed were water temperature and pH. The results showed that the best sludge presentation to be given as additional feed was in treatment 1 with an average weight between 71.33-73.75 grams, an average length ranging from 18.13 to 22.17 cm, and a width of 3.16. – 3.27 cm. Survival Rate is between 275-78%. Specific Growth Rate (SGR) 1%. Specific Weight Growth Rate (SWGR) is between 2-3%. Based on the results, this study recommends that in the use of biogas output sludge as pellets, it is necessary to improve the quality of feed by adding good nutritious ingredients for catfish.

Keywords: Additional feed; bigas; *Claries gariepinus*; cow dung; sludge

1. Introduction

The high cost of fish feed makes many fish farmers complain and reduce the benefit of their businesses. One effort has tried to solve their problems with utilize wastes to make fish feed. In reality, in society, feed is a problem that needs to be solved in fish farming—the provision of sufficient and suitable quality feed to support fish growth. One of the alternative feed ingredients as a substitute for rice bran and a source of vegetable protein that needs to be investigated is biogas.

In addition, biogas can also be used as an alternative source of renewable energy so that it is helpful to help overcome energy needs and scarcity. One of the renewable energy source is biogas. These gases derived from a wide range of organic wastes such as biomass waste, human waste, animal waste through the process of anaerobic digestion and can be used as energy (Putri et al., 2012). The utilization of biogas can reduce environmental problems because biogas produces methane gas and carbon dioxide gas, which, if not used as an energy source, actually causes global warming effects (Gomez et al., 2006).

Production of biogas from cow dung is potential be expanded as fish feed that rich of compound required by fish. Biogas solid waste (sludge) is a suspension of liquid waste and microorganisms from sewage treatment in a wastewater treatment plant, with the relative values generated from the calculation of cow sludge as follows: Crude protein 9.98%, Crude Fat 0.40%, Crude fiber 26,55%, Ash content 42,69%. This proves that the protein content of cow sludge is still high, and the protein can be used for the growth of catfish (Wahyono, 2008).

The addition of solid waste feed (sludge) and reducing expenditure costs are also expected to provide nutrition to fish. In a previous study conducted (Romadhonet et al., 2013), it was found that solid waste (sludge) in the manufacture of biogas for beef cattle (*Bos taurus* L.) contains nutrients in the form of carbohydrates, protein, fat, water content, and ash content. In the previous research concluded that organic pellet feed from cow manure can stimulate the growth of African catfish. Feed was applied to 800 catfish with an average weight of 1.55 grams / head and a length of 10-11 cm (Zulhelmiet et al., 2016).

Aquaculture is one of the community's efforts to maintain food security and increase fish production in the present and future. Fishery cultivation has shown rapid development, both freshwater, brackish, and seawater fisheries. Indonesia's potential needs to be a more recent study of science and development, considering that this wealth still needs to be developed (Mulyadiet et al., 2010).

Catfish is one of the six leading commodities (Darmawan, 2010), is included in 60% of fishery production, which has a high domestic market, freshwater fish commodities are starting to be exported (Assauri, 2007), contributing to the consumption of animal protein in Indonesian society (Saepudin, 2015). This needs to be used as a joint study to spur the development of catfish cultivation. Moreover, West Java is one of the provinces in Indonesia as a fishery producer, which is relatively high. This increase is an advantage for West Java Province, contributing to national fishery production. The novelty of this research to find out alternative fish feed from cow dung biogas at animal husbandry from SWEN Inovasi Transfer Corporate Office, Bogor, West Java.

Based on the above background, researchers are interested in researching the utilization of sludge from cow dung biogas as additional feed for catfish (*Claries gariepinus*) to know the sludge content that is suitable for use supplemental feed**.** So that, this study aimed to determine the level of sludge suitable for use as additional feed.

2. Methods

The research was carried out in Integrated Agriculture, owned by PT. Swen Innovation Transfer which is located on Jl. Cikoneng II, Ciomas District, Bogor Regency. West Java province. The analysis was carried out from September 24 to November 19, 2021. The research subjects were 480 Sangkuriang Catfish (*Clarias gariepinus*). The research method used experimental method (experimental), with a Randomized Block Design (RBD) research design carried out in 3 treatments and one control with three repetitions each.

The variables of this study were cow dung sludge and catfish. Where catfish is the dependent variable and cow dung sludge is the independent variable.

The tools used are nursery ponds made of tarpaulin, fishnet, plastic, thermometer, ruler, gloves, analytical scale, PH meter, hanging scale, filter. The materials used were catfish seed size 13-15 cm, commercial pellets, *Azolla pinnata*, bran, biogas output sludge. Research procedures include:

2.1 Nursery Pond

The nursery pond used is made of tarpaulin using concrete as support. Each treatment pond has a size of 50 x 100 cm as many as 12 pounds. Paranet net serves to facilitate the process of data collection.

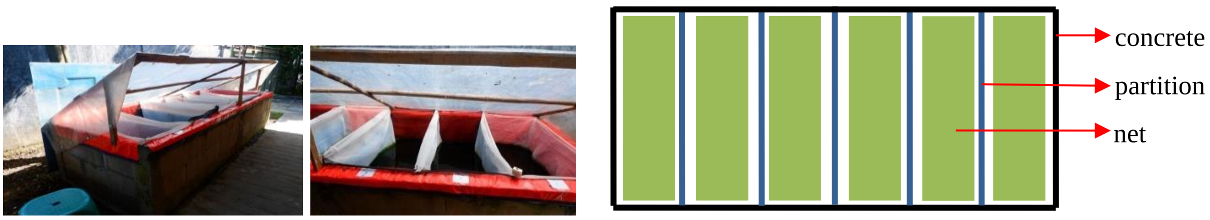

Figure 1. Nursery pond

2.2 Maintenance

The fish used are seeds measuring 12-14 cm. 40 seeds were stocked in each pond. Feeding treatment was carried out for eight weeks. They were feeding three times a day (09.00, 13.00, and 16.30) with a lot of feed 5% of body weight.

2.3 Water Quality Management

The water used comes from a water reservoir with an average pH of 7.8. The pool water is drained once, namely in the 4th week of the study. This is done to overcome the smell of ammonia arising from the feed.

2.4 Test Feed Composition

Feed is given with a weight of 5% of body weight. Feed concentration is given:
Control: 100% commercial pellet
Treatment 1: Bran 10%, Azolla pinnata 10%, Sludge 25%, Pellet 55%
Treatment 2: Bran 10%, Azolla pinnata 10%, Sludge 50%, Pellet 30%
Treatment 3: Bran 10%, Azolla pinnata 10%, Sludge 75%, Pellet 5%

2.5 Measurement

Sampling was carried out at the beginning of the study and every eight weeks. Measurements were made on the fish's weight, length, and width with a random number of 10 fish in each measure.

The data processing analysed included Survival Rate (SR), Specific Growth Rate (SGR), Specific Weight Growth Practices (SWGP), and Feed Conversion Ratio (FCR) based on the results of weekly sampling for eight weeks. The data obtained from the sampling results are recorded, collected, and tabulated. The following is the calculation formula that is analysed.
The first data analysed is the Survival Rate (SR) calculated using the formula following equation (1):

$$SR = (Nt/No) \times 100\% \quad (1)$$

SR represents the Survival Rate of Sangkuriang Catfish (*Clarias gariepinus*) (%), Nt is Number of live fish at the end of rearing (tails), No is Number of fish at the beginning of maintenance (tails).

The second data regarding the Specific Length Growth Rate (SLGR) is calculated using a formula based on the quote (Asmaet al., 2016), namely in equation (2)

$$SLGR = \frac{\ln Lt - \ln Lo}{t} \times 100\% \quad (2)$$

SLGR represents the Specific Length Growth Rate of Sangkuriang Catfish (*Clarias gariepinus*) (%), Lt is Average length of fish at the end of treatment (cm), Lo is Average length of fish at the beginning of treatment (cm), t is Maintenance period (days).

The third, the calculation of the Specific Weight Growth Rate (SWGR), is calculated using a formula based on equation (3)

$$SWGR = \frac{\ln Wt - \ln Wo}{t} \times 100\% \quad (3)$$

SWGR represents the Specific Weight Growth Rate of Sangkuriang Catfish (*Clarias gariepinus*) (%), Wt is Average weight at the end of treatment (grams), Wo is Average weight at the beginning of treatment (grams), t is Maintenance period (days).

3. Result and Discussion

Based on the study results, supplementary feed made from cow dung biogas as the main ingredient, compared with commercial pellet feed as a control, was conducted for eight weeks and obtained eight research data. The results of the research discussed include weight, length, width, Survival Rate (SR), Specific Growth Rate (LPPS), Specific Weight Growth Practices (LPBS), and Feed Conversion Ratio (RKP).

The table 1 includes the results of the feed research consisting of control and three treatments, each with three repetitions. The control treatment ponds were marked as (Control-A, Control B, and Control C), then Treatment 1 was marked (1A, 1B, 1C), Treatment 2 was marked (2A, 2B, 2C), and Treatment 3 was (3A, 3B). 3C).

The test results of Sangkuriang Catfish (*Clarias gariepinus*) feed stated that the weight of the fish given additional feed with a concentration of 25% sludge was almost close to that of catfish with commercial feeder. The resulting consequences can be seen in Table 1.

3.1 Catfish Weight

Table 1. Shows the bodyweight of catfish kept for 56 days ranging from 32.30 grams to 106.25 grams. In the control treatment with three repetitions, the average weight was 95.12 grams to 106.25 grams. Then treatment 1 ranged from 70.70 grams to 73.75 grams. Treatment 2 is between 41.67 grams to 55.05 grams, and Treatment 3 weights 32.30 grams to 34.11 grams. The best supplementary feed was in the 1st treatment test based on body weight analysis.

The data on the weight table of Sangkuriang Catfish (*Clarias gariepinus*) is presented in the following Table 1:

Table 1. Weight of Sangkuriang Catfish (*Clarias gariepinus*)

Week	KA	KB	KC	1A	1B	1C	2A	2B	2C	3A	3B	3C
0	16.33	17.85	18.20	20.31	15.86	19.77	17.02	16.87	18.43	20.59	22.58	19.14
1	22.59	22.40	23.41	23.76	21.58	24.43	19.06	19.72	21.71	19.43	17.99	18.99
2	25.76	28.82	27.53	25.98	26.35	22.26	25.65	24.83	25.68	24.83	22.75	25.21
3	30.58	35.64	33.79	28.48	31.44	30.18	26.80	28.53	26.74	22.07	25.65	21.83
4	40.63	42.89	40.38	30.76	33.25	30.88	28.87	32.28	30.10	24.91	22.77	27.23
5	46.74	52.08	51.76	67.26	40.32	43.30	33.81	36.98	34.10	26.00	27.45	29.68
6	68.46	67.20	70.04	54.36	47.53	50.40	30.92	43.25	37.07	23.43	25.04	23.32
7	66.97	85.70	75.50	55.12	55.83	59.34	39.67	44.94	41.71	23.33	25.91	25.92
8	95.12	102.54	106.25	73.75	70.70	71.33	41.67	55.05	45.04	32.93	32.30	34.11

3.2 Catfish Body Length

The following is data on the body length of the Sangkuriang Catfish (*Claris gariepinus*) listed in the table 2.

Table 2. Body length of sangkuriang catfish (*Claris gariepinus*)

Week	KA	KB	KC	1A	1B	1C	2A	2B	2C	3A	3B	3C
0	13.54	13.76	13.76	14.63	13.31	14.19	13.48	13.26	13.66	14.45	15.15	13.96
1	14.57	14.69	15.16	15.26	14.68	15.59	14.13	14.24	14.87	14.10	13.90	14.67
2	25.76	28.82	27.53	25.98	26.35	22.26	25.65	24.83	25.68	24.83	22.75	25.21
3	30.58	35.64	33.79	28.48	31.44	30.18	26.80	28.53	26.74	22.07	25.65	21.83
4	17.89	18.40	18.31	17.11	17.38	16.36	16.72	16.60	16.95	16.23	15.88	16.72
5	19.08	19.99	19.00	17.92	18.46	18.82	17.56	18.03	17.65	16.36	16.36	17.01
6	21.38	21.22	21.92	20.40	19.50	19.98	17.63	18.95	18.08	15.92	16.14	15.93
7	21.72	23.39	22.65	20.66	20.90	21.30	18.81	19.17	19.04	16.62	16.52	16.82
8	23.94	24.45	25.25	22.71	22.07	22.17	18.13	20.11	18.87	17.38	17.54	17.24

Table 2. Shows that the results of treatment for 56 days with eight times of data collection obtained the longest fish measurements, namely in treatment one with a body length range between 22.07 cm to 22.71 cm when compared to the body length of fish in the control pond with a range of 13, 94 cm to 25.25 cm.

3.3 Catfish Body Width

Data on the body width of Sangkuriang Catfish during rearing are presented in the following table 3. Table 3. This shows that the results of the treatment measurements were compared with the control. The fish body in the broadest vector section was in treatment one with a body width ranging from 3.16 cm to 3.27 cm compared to the body length of fish in the control pond ranging from 3.67 cm to 3.80 cm.

Table 3. Body width of sangkuriang catfish (*Claries gariepinus*).

Week	KA	KB	KC	1A	1B	1C	2A	2B	2C	3A	3B	3C
0	1.92	1.86	1.90	2.03	1.75	2.13	1.87	1.83	1.95	2.34	2.26	2.00
1	2.08	2.00	1.95	1.95	1.86	1.76	1.35	1.75	2.01	2.00	1.85	1.93
2	2.19	2.01	2.15	1.51	2.19	2.02	2.05	2.29	2.32	2.25	2.26	2.61
3	2.38	2.58	2.64	2.31	2.54	2.35	2.25	2.38	2.27	2.17	2.21	1.98
4	2.68	2.71	2.71	2.33	2.58	2.43	2.39	2.53	2.42	2.17	2.05	2.21
5	2.78	2.83	2.87	2.47	2.64	2.60	2.37	2.50	2.37	2.01	2.18	2.29
6	3.38	3.30	3.40	3.04	2.95	2.93	5.50	2.66	2.53	2.00	2.05	2.11
7	3.29	3.51	3.44	2.94	2.98	5.00	2.58	2.66	2.58	2.15	2.17	2.28
8	3.67	3.78	3.80	3.23	3.27	3.16	2.65	3.02	2.77	2.61	2.66	2.82

3.4 Fish Survival Rate

The survival rate of Sangkuriang Catfish during maintenance is presented in the following Table 4. Table 4 Presents Survival Rate (SR) data which is the number of fish that can survive during the maintenance period. Based on the results of research on the survival rate of Sangkuriang Catfish (*Clarias gariepinus*), it is known that the SR of tilapia ranges from 65% - 78%. The SR value in treatment one pool was between 75-78%, treatment 2 was around 70-78%, and treatment pool 3 was between 65-70%. This means that the best SR value compared to the control pool is in treatment 1A, 1B, and 1C with a range of 75-78%. The highest of survival of fish is obtained from the treatment of fish given commercial feed because at this treatment the level of cannibalism was low. Fish cannibalism is low because it uses floating feed types and sufficient nutrient content (high protein). Commercial fish feed used during this research was floating type feed and it will be easily eaten by fish before the feed reaches the bottom of pond (Arisaet al., 2018).

Table 4. Survival rates of sangkuriang catfish (*Claries gariepinus*)

Treatment	Nt (catfish)	No (catfish)	(Nt/No)	SR = (Nt/No) X 100%
A Control	28	40	0.7	70%
B Control	30	40	0.75	75%
C Control	30	40	0.75	75%
1A	31	40	0.775	78%
1B	31	40	0.775	78%
1C	30	40	0.75	75%
2A	29	40	0.725	73%
2B	28	40	0.7	70%
2C	31	40	0.775	78%
3A	28	40	0.7	70%
3B	27	40	0.675	68%
3C	26	40	0.65	65%

The thing that resulted in the death of catfish in treatment 3 was a lack of feed that could support survival because commercial feed could not be reduced to 75%. What resulted in death in the control pond was caused by the end of catfish caused by stress and also water content containing ammonia.

3.5 Specific Length Growth Rate (SLGR)

Based on the results of research on the length growth rate of catfish fry (*Clarias gariepinus*), which were given additional feed, the SLGR value ranged from 0% - 1%. This shows that the addition of feed can increase the growth rate of catfish, including artificial feed has a significant effect (as indicated by the value ($P < 0.05$) [9]. Specific Length Growth Rate (SLGR) is presented in the table 5 below.

Table 5. Specific Length Growth Rate (SLGR)

Treatment	Lt (cm)	lnLt	Lo (cm)	lnLo	t (day)	lnLt - lnLo	lnLt - lnLo / t	SLGR
A Control	23.94	3.18	13.54	2.61	56	0.57	0.01	1%
B Control	24.45	3.20	13.76	2.62	56	0.57	0.01	1%
C Control	25.25	3.23	13.76	2.62	56	0.61	0.01	1%
1A	22.71	3.12	14.63	2.68	56	0.44	0.01	1%
1B	22.07	3.09	13.31	2.59	56	0.51	0.01	1%
1C	22.17	3.10	14.19	2.65	56	0.45	0.01	1%
2A	18.13	2.90	13.48	2.60	56	0.30	0.01	1%
2B	20.11	3.00	13.26	2.58	56	0.42	0.01	1%
2C	18.87	2.94	13.66	2.61	56	0.32	0.01	1%
3A	17.38	2.86	14.45	2.67	56	0.18	0.00	0%
3B	17.54	2.86	15.15	2.72	56	0.15	0.00	0%
3C	17.24	2.85	13.96	2.64	56	0.21	0.00	0%

3.6 Specific Weight Growth Rate (SWGR)

The particular weight growth rate is presented in Table 6 below.

Table 6. Specific Weight Growth Rate (SWGR)

Treatment	Wt (g)	lnWt	Wo (g)	lnWo	t (day)	lnLt - lnLo	lnLt - lnLo / t	SWGR
A Control	95.12	4.56	16.33	2.79	56	1.76	0.03	3%
B Control	102.54	4.63	17.85	2.88	56	1.75	0.03	3%
C Control	106.25	4.67	18.20	2.90	56	1.76	0.03	3%
1A	73.75	4.30	20.31	3.01	56	1.29	0.02	2%
1B	70.7	4.26	15.86	2.76	56	1.49	0.03	3%
1C	71.33	4.27	19.77	2.98	56	1.28	0.02	2%
2A	41.67	3.73	17.02	2.83	56	0.90	0.02	2%
2B	55.05	4.01	16.87	2.83	56	1.18	0.02	2%
2C	45.04	3.81	18.43	2.91	56	0.89	0.02	2%
3A	32.93	3.49	20.59	3.02	56	0.47	0.01	1%
3B	32.3	3.48	22.58	3.12	56	0.36	0.01	1%
3C	34.11	3.53	19.14	2.95	56	0.58	0.01	1%

Based on Table 6 the results of research on the growth rate of seed weight of Sangkuriang Catfish (*Clarias gariepinus*), which was given additional feed, the SWGR value ranged from 1% - 3%. This shows that the addition of feed can increase the growth rate of catfish, including artificial feed has a significant effect (as indicated by the value (P <0.05) (Bakteriet al., 2014).

During this research, the growth rate if fish fed with low sludge cow dung formulation lower than fish given commercial feed was due to the type of food that could be categorized as drowning food, so that when it was spread on the water it reached the bottom immediately. This research was anticipated through the provision of lift nets as a place to put food so that it did not fall directly to the bottom of pond. However, fish that will eat food in the net, the fish must swim into the net first and compete with other fish to get the food. Fish with more active will eat a lot. Fish growth not homogeneous, so fish that are eat a lot will grow well and faster. Fish growth is influenced by energy from the food consumed. Digested feed will produce a supply of energy that can be used for the body's metabolism and the rest will be used for growth (Trisnawatiet al., 2014).

Based on the study results, water quality is essential for cultivation (Hernowoet al., 2010). Not only that the temperature is calculated, the temperature ranges from 25-31, which is included in the temperature range that is suitable for the life of catfish, according to (Lestariet al., 2013), stating the temperature Water can affect the survival rate of fish, morphological growth, reproduction, and behaviour because if the temperature is too high, it will cause stress and death.

The pH value of the water can identify the balance between base and acid in the water, which is a measurement of the concentration of hydrogen ions in water (Patang, 2012). Based on the measurement results, the pH ranges from 7.4 to 7.8, which indicates that the water's pH is expected. The appropriate pH for catfish rearing is in the range of 6-9 (Monalisa, 2010).

Biogas is bio-gas produced from the fermentation process of organic materials with the help of anaerobic bacteria used to meet household energy needs that are cheap and environmentally friendly. In addition to the energy benefits obtained from the anaerobic digestion process, side products such as sludge are also obtained. Sludge material can be used as fertilizer in the form of liquid fertilizer and solid fertilizer. Besides being used as fertilizer, biogas waste can be used as raw material for fish feed. Content of pathogenic bacteria in the second-month biogas waste has disappeared so that it is safe to use as raw material for fish feed (Watanabe, 1988). In addition, the nutritional content in biogas waste is optimal for use as a raw material for fish feed (Priyanto, 2011).

The selection of biogas sludge as feed can reduce the cost of fish feed production. The increasing need for fish feed is accompanied by the high price of manufactured feed. Manufacture of household industry-scale feed is considered quite promising as an alternative feed (Sujono, 2014).

Fermented cow dung from a biogas reactor with a nutrient content of about 9.98% crude protein, 0.40% crude fat, Crude fiber 26.55%, Ash content 42.69% (Wahyono, 2008). The bran contains 88.93% dry matter nutrition, 12.39% crude protein, 12.59% crude fiber, 0.09% calcium, and 1.07% phosphorus (Utami, 2011). And *Azolla pinata* is very rich in protein, essential amino acids, vitamins (vitamin A, vitamin B12, and Beta-Carotene), minerals such as calcium, phosphorus, potassium, iron, and magnesium. Based on its dry weight, it contains 25 -35% protein, 10-15% minerals, and 7-10% amino acids, bioactive compounds, and biopolymers (Widodo, 2010).

Feed ingredients derived from biogas waste can be used in the preparation of organic fish feed and can be used as a mixture of cheap and high-quality fish feed ingredients so that they can increase income for fish-cultivating communities, especially in Malang Raya (Tariganet al., 2019). The use of biogas waste can replace pollard raw materials in fish feed formulations supported by the fact that sludge is a potential source of alternative raw material for cheap fish feed with adequate quality carbohydrate nutrients accompanied by with guaranteed quantity and availability throughout the year. It needs to be a big concern for breeders to try a choice of solutions and develop them as much as possible (Nugroho, 2010).

Thus, in terms of feed raw materials other than biogas waste, the price fluctuates, and the quality is unstable, which affects feed quality. As well as the level of profit obtained from fish farming is strongly influenced by the total cost of feed issued, where feed costs can reach 60 -70% of all production costs needed for fish farming. The dependence on the use of finished feed produced by feed companies is still high, where most of the feed ingredients are still imported (Tariganet al., 2019).

4. Conclusions

Based on the research results, the best sludge presentation to be given as additional feed was in treatment 1 with an average weight between 71.33-73.75 grams, an average length ranging from 18.13 to 22.17 cm, and a width of 3.16. – 3.27 cm. Survival rate between 20 - 25%. Specific Growth Rate (SGR) 1%. Specific Weight Growth Rate (SWGR) is between 2-3%. Based on the results, the researcher recommends that in the use of biogas output sludge as pellets, it is necessary to improve the quality of feed by adding good nutritious ingredients for catfish. Application of cow dung biogas (sludge) for producing other fishes like common bream fishes can be taken up in future research mainly to study the effect of cow dung biogas (sludge) on increasing the survival and growth rate of that species.

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