Fisheries Journal, 14(2), 919-931 (2024)
http://doi.org/10.29303/jp.v14i2.834

VALUE OF UTILIZING AGRICULTURAL WASTE FOR FISH FEED (CASE STUDY OF FISH PELLET FEED)

Nilai Pemanfaatan Limbah Pertanian Untuk Pakan Ikan (Studi Kasus Pakan Pelet Ikan)

Eko Sumartono[1], Mujiono[1*], Johnny Oktapriza[2], Fetri Yuliana[3]

[1]Agribusiness Study Program,Faculty of Agriculture, Dehasen University Bengkulu, [2]Regional Planning and Development Agency, Central Bengkulu Regency, [3]Livestock and Animal Health Services Bengkulu Province

Meranti Raya Street No. 32 Sawah Lebar Bengkulu City, Indonesia 38228

*Corresponding Author: mujiono@unived.ac.id

(Received May 3rd 2024; Accepted June 24th 2024)

ABSTRACT

Most of the residents in Central Bengkulu Regency work as farmers, in addition to raising livestock and as fish cultivators. This condition needs serious attention from the local government and related stakeholders. The issue of feed has a large proportion of the sustainability of livestock businesses. On the other hand, palm fronds as post-harvest agricultural waste and bran as post-processing waste have not been utilized optimally. Even though the nutritional content contained in it is quite high. Agricultural and plantation waste by-products have good potential to be utilized as fish feed. The purpose of the research was to conduct a combination processing (physical, chemical, biological) of materials for floating pellets and analyze their nutritional content. Testing was conducted in a laboratory that consistently applies ISO/IEC 17025:2017 from the National Accreditation Committee (KAN), namely the Livestock Service Office of East Java Province. The standard of test results refers to SNI 01-4087-2006 concerning Catfish Artificial Feed (Enlargement). Fish feed (pellets) that meet SNI 01-4087-2006 contains 3 types of content including ash content, crude fat, and aflatoxin. The types of content that do not meet SNI are crude protein, crude fiber, phosphorus, buoyancy and pellet diameter. The estimated cost of making fish feed (pellets) is around Rp. 6,100 per kilogram. Cost analysis is relevant to feed quality and daily needs without reducing nutritional value. Further research is needed to ensure that artificial feed is more cost-effective than conventional feed.

Keyword : Agricultural Waste; Fish Pellets; Value

ABSTRAK

Penduduk di Kabupaten Bengkulu Tengah sebagian besar berprofesi sebagai petani, selain beternak juga sebagai pembudidaya ikan. Kondisi ini perlu mendapat perhatian serius dari pemerintah daerah dan pemangku kepentingan terkait. Persoalan pakan mempunyai proporsi yang besar terhadap keberlangsungan usaha peternakan. Di sisi lain, pelepah sawit sebagai

limbah pertanian pasca panen dan dedak sebagai limbah pasca pengolahan belum dimanfaatkan secara optimal. Padahal kandungan nutrisi yang terkandung di dalamnya cukup tinggi. Hasil samping limbah pertanian dan perkebunan mempunyai potensi yang baik untuk dimanfaatkan sebagai pakan ikan. Tujuan penelitian yaitu melakukan pengolahan kombinasi (fisik, kimia, biologi) bahan untuk pelet apung dan menganalisis kandungan nutrisinya. Pengujian dilakukan di laboratorium yang konsisten menerapkan ISO/IEC 17025:2017 dari Komite Akreditasi Nasional (KAN) yaitu Dinas Peternakan Provinsi Jawa Timur. Standar hasil pengujian mengacu pada SNI 01-4087-2006 tentang Pakan Buatan Ikan Lele (Pembesaran). Pakan ikan (pelet) yang memenuhi SNI 01-4087-2006 mengandung 3 jenis kandungan antara lain kadar abu, lemak kasar, dan aflatoksin. Jenis kandungan yang tidak memenuhi SNI adalah protein kasar, serat kasar, fosfor, daya apung dan diameter pelet. Estimasi biaya pembuatan pakan ikan (pelet) berkisar Rp. 6.100,- per kilogram. Analisis biaya relevan dengan kualitas pakan dan kebutuhan sehari-hari tanpa mengurangi nilai gizi. Diperlukan penelitian lebih lanjut untuk memastikan pakan buatan lebih hemat biaya dibandingkan pakan konvensional.

Kata Kunci: Limbah Pertanian; Nilai; Pelet Ikan

INTRODUCTIONS

Central Bengkulu is one of the districts in Bengkulu Province with a population of 114,695 people. Most of the population works as farmers, as well as livestock breeders (BPS Provinsi Bengkulu, 2019). The livestock population in Central Bengkulu, ranging from cows, buffalo, goats to sheep, has reached 34,065 heads with the majority of grazing systems carried out using mix farming, aka herding livestock around oil palm plantations (Azizah, 2021). Meanwhile, in the fisheries sector, Central Bengkulu Regency has 982 cultivators with a total production of 559 tons per year (BPS Provinsi Bengkulu, 2019). In fact, fish cultivation using the biofloc system has now begun to be developed by the Bengkulu Province Maritime and Fisheries Service.

Referring to the description above, the livestock and fisheries sector needs serious attention from the regional government and related stakeholders. One of them is the problem of feed. Haryo *et al.* (2017) stated, that this was because feed is the most important factor in the livestock business because its contribution reaches 70% of the total production costs, so its supply and use must be planned well.

Apart from that, bran as a by-product of rice milling can also be used as fish feed in the form of floating pellets. Rice bran is an agricultural waste that is easy to find, relatively inexpensive and has nutritional content that is no less interesting, including 86.5% dry matter, 8.7% ash, 10.8% crude protein, 11.5% crude fiber, 5% fat 1%, extract material without nitrogen (BETN) 50.4%, calcium 0.2% and phosphorus 2.5% (Adlan & Ibrahim, 2021). Substitution of tofu dregs, rice bran and other ingredients is a source of raw materials that can be used to make fish feed according to the Indonesian National Standard (SNI). The profitability of fish farming operations is very important for all fish farmers, but freshwater fish farmers must have access to a balanced, cost-effective and optimal fish feed. The practice of processing artificial fish feed as a prerequisite for profitable production (Nurhaita *et al.,* 2016).

Feed raw materials are becoming increasingly important, especially if you look at the cost structure of livestock production. Local feed raw materials have potential not only in terms of providing nutritional sources, but also in their ability to produce high-quality functional feed ingredients (Indah *et al.,* 2020). Agricultural and plantation waste by-products have good potential for use as animal feed. However, the abundant availability of agricultural and plantation by-

products requires further processing and analysis.

Utilization of tofu dregs and rice bran as fish feed Tofu dregs are waste products of tofu agro-industry that have not been utilized optimally or are still raw (Robbani *et al*., 2022). Meanwhile, rice bran is the output of processing rice into rice, where the quality of rice bran will vary depending on the type of rice (Malianti *et al*., 2019). Judging from its texture, some people and researchers still refer to rice bran as fine bran. In one sack of rice, 65% of rice can be produced and 35% of milled waste consisting of bran husks (25%) and rice bran (10%). The protein content of fine bran/bran ranges from 12-14% fat around 7-9%, crude fiber around 8-13%, and ash around 9-12% (Aprillya *et al*., 2019; Mila & Sudarma, 2021).

Figure 1. Dregs (wet) Tofu

Figure 2. Fine Rice Bran

According to several studies, the use of 30% fermented rice bran using the probiotic *Aspergillus niger* as feed can increase the digestibility and growth of tilapia (Admin, 2020). Providing probiotics such as *Bacillus sp., Lactobacillus sp., Aspergillus* and *yeast* (Acetobacter) as probiotics for rice bran flour can increase the fish's digestibility of feed so that it is easily absorbed and used as a deposit for fish growth and survival (Admin, 2020).

In an effort to reduce the high amount of crude fiber in bran, it needs to be fermented using probiotics. Fermentation is an effort to improve the quality of nutrients, reduce and even eliminate the influence of certain feed ingredients which can be done using microorganisms. Fermentation is a process of chemical changes that occur in a substrate as a result of the activity of an enzyme from a microorganism (Ikhwanuddin & Putra, 2018)

Research is expected not only to be carried out and utilized at a limited time and among limited groups. But it must also have a purpose and have a broad impact so that it is feasible to be developed in the next 5 to 20 years. Therefore, a road map (research road map) is needed so that it can be explained explicitly what is being done (T1) with what will be developed (T2) and what will be built (T3) in relation to the utilization of agricultural waste for animal feed.

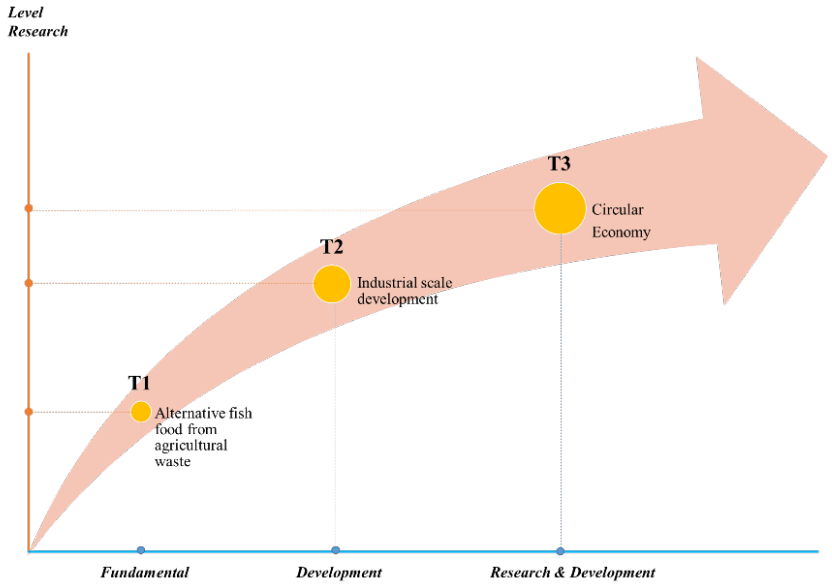

Figure 3. Research Road Map

Research on the use of agricultural waste into animal feed can always be the basis or capital for industrial development both on a household scale (homemade) and Micro, Small and Medium Enterprises (MSMEs). In the future, waste management can become a circular economy model for community empowerment and has the potential to increase village and regional (PAD) original income. Of course, by conducting further research at the level of Technology Readiness Level (TKT) 7 – 9.

Formulation of the problem

1. How is the combination processing of floating pellet animal feed?
2. What are the results of the nutrient content analysis of floating pellets?

Research Purposes

1. Physical, chemical and biological treatment of agricultural waste
2. Conduct laboratory analysis/testing of the nutrient content of floating pellets

Research Limitations

1. The waste used for feed comes from post-processing (bran)
2. The processed and analyzed feed is used for aquaculture

METHODS

Time and Location of Research

Research on the Utilization of Agricultural Waste into Animal Feed was carried out for three months, from April to June 2023. The research location was carried out in Central Bengkulu Regency on a Laboratory scale.

Data Analysis

The equipment and materials for making floating pellets for aquaculture differ only in the main ingredients, namely rice bran (pellets). In general there is no significant difference. The following shows the equipment and materials used.

Table 1. Manufacturing Equipment and Materials

CULTIVATED FISH FLOATING PELLET	
Tools	**Material**
1) Penepung Machine	1) Rice bran* (DD)
2) Gloves	2) Tofu dregs (TF)
3) Bucket	3) Viterna Plus (BT^1)
4) Scales	4) Probiotics (BT^2)
5) Measuring cup Stirrer	5) Molasses (BT^3)
	6) Tapioca Flour (BT^4)
	7) Vitamin Booster (BT^5)

**) agricultural waste basalt raw material*

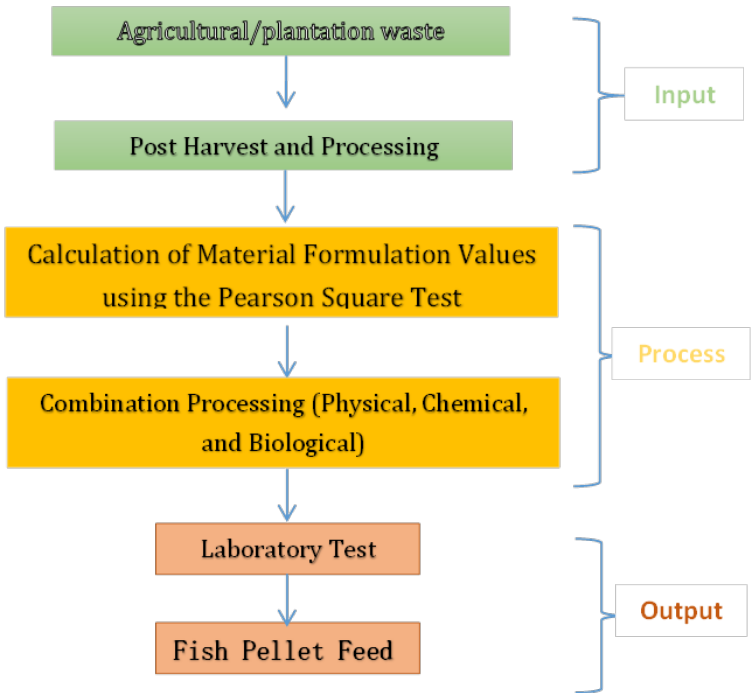

Figure 4. Research Flowchart

Data Analysis Stages

1) Preparation of Tools and Materials

Equipment is provided from the nearest store and location, given the limited time. Equipment and materials as mentioned in the table above, are searched for and collected using land transportation (cars and motorcycles).

2) Preparation of Feed Formulation

The formulation of fish floating pellets in this study uses the Pearson Quadrilateral Method which aims to describe the nutritional levels of protein, fat, carbohydrates or other nutrients needed (Surianti, Hasrianti, Wahyudi, & Irwan, 2021). The following is an overview of the formulation;

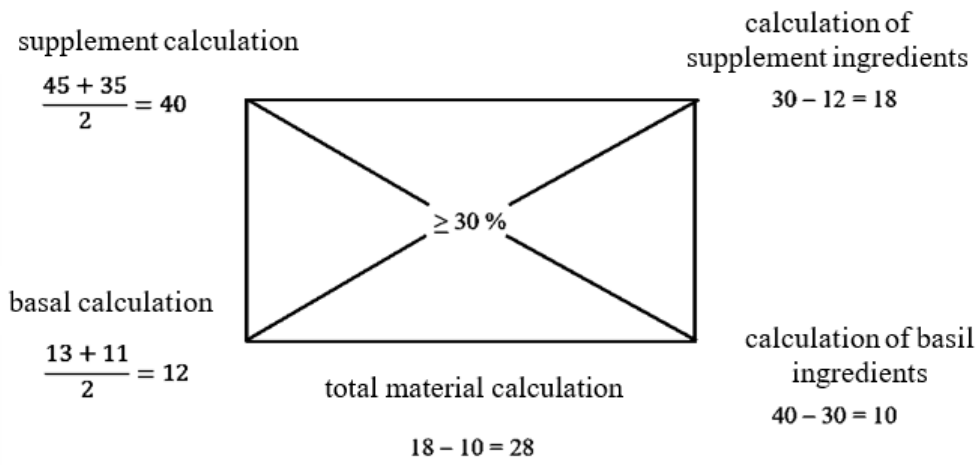

Figure 5. Feed Formulation

From the formulation that the researcher processed above, the ratio or ratio between ruminant feed and floating fish pellets was then made as follows;

$$\text{Pellet Ratio} = DD + TF + BT^{12345}$$

Figure 6. Fish Floating Pellet Feed Ratio

Description;
DD : Rice bran
TF : Tofu dreg
BT : additional ingredients

3) Combined Processing of Cultivated Fish Floating Pellets

Physical processing of the bran is done by heating to stabilize the bran so it doesn't go rancid during storage. Pelleting can also be done by improving the nutritional value of the bran, this treatment can improve the perishability and bulkiness of the bran, so that feed consumption increases (Suryani, Hernaman, & Neng, 2017). The bran does not need to be ground again because the texture of the material chosen is quite smooth.
Meanwhile, chemical (addition of Viterna Plus) and biological (addition of microorganisms; EM4) treatments aim to increase nutrient levels and reduce pesticide residue levels. This combination will change food from very complex ingredients to simpler compounds.

4) Laboratory Test

Laboratory tests use Proximate and Van Soest Analysis with reference to the Fattening Beef Cattle Concentrate standard (SNI 3148-2:2017) and the Artificial Feed standard for Catfish (SNI 01-4087-2006). These two types of analysis and their references are intended to determine the nutritional value contained in samples of ruminant feed and floating fish pellets so that they are safe and suitable for use. In order to obtain maximum results, testing is carried out in laboratories that consistently apply ISO/IEC 17025: 2017 from the National Accreditation Committee (KAN). The following is a sample and nutritional test parameters.

Table 2. Samples and Nutrient Parameters Tested

Testing Ground	Test Sample	Nutrition Parameters Tested
Animal Husbandry Feed Laboratory East Java Province. Address : Jl. Ahmad Yani No. 202, Surabaya, East Java, 60235 Accredited KAN : LP-1267-IDN Valid until; 18 November 2027	Fish Pellet (Code: 2)	1) Moisture Content (AIR) 2) Ash Content (ABU) 3) Crude Protein (PK) 4) Crude Fat (LK) 5) Crude Fiber (SK) 6) Calsium (Ca) 7) Phosfor (P) 8) Extract Material Without Nitrogen (BETN) 9) Aflatoksin (AF)

Testing in the laboratory, researchers conducted a buoyancy test which is a benchmark in determining the quality of fish feed. This is because some types of fish prefer floating feed compared to sinking feed,(Husain, Bahri, & Gubali, 2020). Manual testing is carried out by dropping the pellets into the water followed by calculating the feed time from the first time it hits the water until it sinks at least 10 minutes x 3 times of feeding with pellet sizes ranging from 0.6 to 1 mm.

RESULTS

Preparation and Processing of Feed Ingredients.

On April 16 2023, researchers prepared materials in the form of tofu dregs and palm fronds. The next day the researchers dried 50 kilograms of tofu dregs while peeling the palm fronds and cutting them into 1-2 cm sizes and then mixing them with molasses and EM4. The chopped fronds are then fermented in a container for + 2 weeks (May 20 to June 5, 2023) at room temperature.

Figure 7. Tofu Dregs Drying (left) and the Results (right)

Figure 8. Viterna Plus Organic

Figure 9. Boster Vitamin

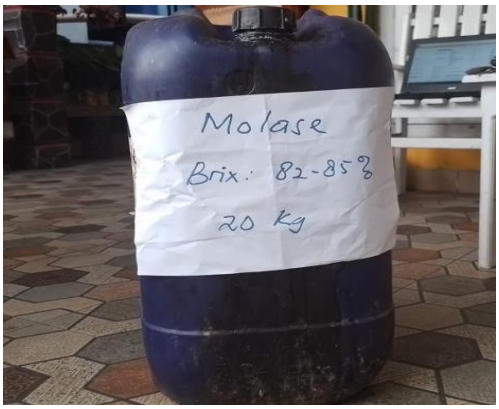

Figure 10. Molasses

Figure 11. Probiotic (EM4)

Reasons for using the product/brand are due to nutritional adequacy, affordable cost and commonly used by farmers and safety against pollution risks. In the same week, researchers also shopped for ingredients, starting from Molasses, Probiotics (EM4), and other necessary supplement ingredients both via online shops and in nearby shops (Bengkulu City). The documentation of materials purchased is as follow;

Fermented feed ingredients are then dried for 2 to 3 days directly under the hot sun. The dried palm fronds, tofu dregs and bran are then ground using a disk mill with a power of 5.5 PK. Specifically, tofu dregs and bran that have been ground and then filtered (sieved) manually. The following is documentation of the treatment.

Figure 12. Material Grinding

Figure 13. Material Screening

The next step is to mix the basal (main) raw material with the supplement material according to the Pearson Quadrilateral Method (Pages 7 and 8). The mixed ingredients are then steamed with the aim of killing harmful bacteria and increasing the digestibility of the feed. Then remove it and drain it, then put it in a container (bucket) to ferment for + 2 weeks.

Figure 14. Measuring and Mixing Materials Figure

Figure 15. Feed Steaming (Blanching)

The fermented feed is then sent to the East Java Province Animal Husbandry Service Feed Laboratory for testing/analysis of its nutritional content. While waiting for the laboratory test results, the researchers printed the feed and dried it. Fish pellets are printed using a horizontal (wet) machine. The two feeds that have been printed are then dried under the hot sun. The identities of the samples tested are as follows;

Table 3. Feed Sample Identity

Code	Type of Feed	Specific Gravity	Condition
2	Farmed Fish Pellets (Catfish)	900 grams	Good/Ready to Test

Test Results and Discussion of Fish Feed

The testing period for fish feed (pellets) starts from 15 to 22 June 2023. Based on the Test Results Report Number: LP-LHP/146/252/VI/2023 (attached) the following details are obtained.

Table 4. Pellet Feed Laboratory Test Results (Enlargement), Reference : SNI 01-4087-2006

No.	Test Type Unit	SNI Pellets (Catfish – Enlargement)	Test Results	
			Percentation	Category
1.	Water Content, max	12 %	61,67	BM
2.	Ash content, max	13 %	7,72	M
3.	Crude Protein, min	25 %	16,63	BM
4.	Crude Fat, min	5 %	6,11	M
5.	Crude Fiber, max	8 %	15,76	BM
6.	Phosphor (%)	1,2 %	0,62	BM
7.	Aflatoxin, max	20 (µg/kg)/negatif	<12,9	M
8.	Buoyancy, min	5 minutes	< 5 minute	BM
9.	Pellet diameter	3 - 4 mm	Not necessarily	BM
10	Non Protein Nirogen, max	0,20 %	Not tested	Not vailable

Source : Primary Data is processed, 2023

Description : M= meets SNI; Mn = approaching SNI, not yet meeting SNI (BM)
*) refers to other sources or literature

DISCUSSIONS

Test Results Meet SNI

Based on the information in the table above, the nutritional content of fish feed (pellets) that meets SNI 01-4087-2006 concerning Artificial Feed for Catfish (Growing Up) is 3 types including ash content (7.72 percent), crude fat (6.11 percent) and aflatoxin (<12.9 µg/kg). The ash content indicates the mineral content contained in the feed. The higher the ash content, the higher the mineral content in it (Sukria & Krisnan, 2009). Animal feed must contain minerals because livestock need them, even in small amounts. Meanwhile, crude fat is an important nutrient for fish pellets with a minimum standard of 5 percent.

Test Results Do Not Meet SNI

The next nutritional content that does not meet SNI is crude protein (16.63 percent), crude fiber (15.76 percent), phosphorus (0.62 percent), buoyancy (< 5 minutes) and pellet diameter (indeterminate). Pellet (floating) protein on the market ranges from 14 to 52 percent, of course with prices varying from IDR 8,000 to IDR. >100,000 per kilogram. Protein is used for growth and as an energy source for fish. The closer it is to harvest time, the less protein requirements there are. It is highly recommended not to use too much protein, because it is not used optimally by the fish and can cause pollution.

Crude fiber affects digestibility, so a good feed does not contain more than 8 percent crude fiber. Laboratory test results still show that the crude fiber content is quite high, which forms pores in the feed (Dilaga *et al.,* 2022). This also affects the low buoyancy (floating). As also stated in the Journal of Technology and Science Research, the higher the pores and absorption capacity formed, the lower the buoyancy.

Pellets have various types of sizes, generally ranging from 0.5 to 4 mm. Selection is based on the opening and size of the fish's mouth. In this study, the size of the pellets was uncertain due to the limitations of the printing machine so they had to be broken up by hand to get a smaller size. The pellets should be printed using a vertical machine (dry immediately) so that it doesn't take a lot of time for the drying process.

What is meant by Non-Protein Nitrogen (NPN) is a non-protein compound that contains nitrogen, for example amino acids. If added to feed it is thought to have a positive effect on growth and to some extent able to reduce feed costs (Manson *et al.,* 2022; Ahmad & Rusmaedi, 2017). The NPN content was not tested in this study because it was not on the service list at the East Java Animal Husbandry Service Feed Laboratory.

Cost Analysis for making fish feed (pellets)

Analysis of feed manufacturing costs is needed to estimate the costs incurred and the profits obtained per kilogram and/or per ton. Cost analysis is relevant to feed quality and daily requirements without reducing nutritional value. Following are the calculations.

Table 5. Feed Manufacturing Cost Details

No.	Material Composition	Amount of Ingredients (Kg/people)	Rupiah Value (Rp.)
1	Bran	2,8	5.600
2	Plp Powder. Palm	0	0
3	Tofu Dregs	6,36	25.440
4	Labor	1	10.000
5	Fuel	1	10.000
6	Supplementary material	1	10.000
	Total	10 kg	61.040

Source : Primary Data is Processed, 2023

Calculation (Commercial) of Fish Feed
Estimated profit (10%) = Feed Cost (1 Kg) × 10%
= Rp. 6,100 × 10%
= Rp. 610,-

So, Selling Price of Feed
= Cost of Feed (1 Kg) + Estimated Profit (10%)
= Rp. 6100 + Rp. 610
= Rp. 6,710 per kg

If, feed is produced on a large scale or with a capacity of 1,000 kg/day, the estimated profits obtained are:
Fish Feed = Estimated profit (10%) × 1000 Kg
= Rp. 671 × 1000 Kg
= Rp. 671,000 per Kg/day

From the analysis orcalculations above, it can be concluded that the estimated profit from large-scale production in 1 month (30 days), namely;
Fish Feed = 30 Days × Rp. 671,000
= Rp. 20,130,000 per month

CONCLUSIONS

The main feed ingredients consist of post-harvest (3 and 10 year old palm fronds) for ruminants and post-processing (rice bran) for fish pellets. The main ingredients (basalt) and additional ingredients (supplements) are processed physically, chemically and biologically. Physical processing of palm fronds is carried out by cutting into smaller pieces, grinding, heating, soaking and drying. Next, the ingredients are formulated using Pearson's Quadrilateral Method with the aim of describing the nutritional levels of protein, fat, carbohydrates or other nutrients needed. Meanwhile, chemical and biological treatment involves fermentation using bioactivators. Through fermentation technology, ingredients with low nutritional content can be improved so that their feed value increases.

Fish feed (pellet) test results are based on SNI 01-4087-2006 concerning Artificial Feed for Catfish. The nutritional content that meets SNI includes levels of ash, crude fat and aflatoxin. Meanwhile, the nutritional content that is not sufficient is water content, crude protein, crude fiber, phosphorus, buoyancy and pellet diameter. If the pellets are to be used as local feed then the existing protein is sufficient, but if they are to be bought and sold then they must at least be reformulated and modified and printed with a capable machine.

ACKNOWLEDGEMENT

Thank you to Regional Planning and Development Agency Central Bengkulu Regency, Institute for Research and Community Service Dehasen University Bengkulu and Agribusiness Study Program, Faculty of Agriculture, Dehasen University Bengkulu

REFERENCES

Adlan, Z. U., & Ibrahim, W. (2021). Kandungan Fraksi Serat Pelepah Kelapa Sawit dengan Teknologi Pengolahan Pakan. *Jurnal Peternakan (Jurnal of Animal Science)*, *5*(1), 5–9. https://doi.org/10.31604/JAC.V5I1.3083

Admin. (2020). Dedak dan Bekatul – Dinas Peternakan & Kesehatan Hewan Provinsi Nusa Tenggara Barat.

Admin Prahu Hub. (2020). Dedak Padi Sebagai Bahan Utama Pakan Ternak.

Ahmad, T., & Rusmaedi, R. (2017). Pemanfaatan Berbagai Sumber Nitrogen Non Protein Pada Pembesaran Ikan Bandeng di Laut. *Jurnal Penelitian Perikanan Indonesia*, *11*(1), 51. https://doi.org/10.15578/JPPI.11.1.2005.51-57

Aprillya, M. R., Suryani, E., & Dzulkarnain, A. (2019). The analysis of quality of paddy harvest yield to support food security: A system thinking approach (case study: East Java). *Procedia Computer Science*, *161*, 919–926. Elsevier B.V. https://doi.org/10.1016/j.procs.2019.11.200

Azizah. (2021). Titik - Titik Kritis Sistem Penggembalaan Ternak Sapi Dengan Sistem Integrasi Sawit - Sapi - Direktorat Jenderal Peternakan dan Kesehatan Hewan, Kementerian Pertanian.

BPS Provinsi Bengkulu. (2019). Badan Pusat Statistik Kabupaten Bengkulu Tengah.

Dilaga, S. H., Putra, R. A., Pratama, A. N. T., Yanuarianto, O., Amin, M., & Suhubdy, S. (2022). Nutritional quality and in vitro digestibility of fermented rice bran based on different types and doses of inoculants. *Journal of Advanced Veterinary and Animal Research*, *9*(4), 625–633. https://doi.org/10.5455/JAVAR.2022.I632

Haryo, M., Rifin, A., & Sanim, B. (2017). Factors Affecting Profitability on Animal Feed Companies in Indonesia. *Agro Ekonomi*, *28*(2), 289. https://doi.org/10.22146/jae.26034

Husain, F., Bahri, S., & Gubali, S. I. (2020). Evaluasi Kandungan Lignin dan Tannin Pada Kulit Pisang Goroho (Musa acuminafe, sp) Fermentasi Sebagai Pakan Ternak Ayam Ras Petelur. *Jambura Journal of Animal Science*, *3*(1), 26–30. https://doi.org/10.35900/JJAS.V3I1.5216

Ikhwanuddin, M., & Putra, A. N. (2018). Utilization of Rice Bran Fermentation with Aspergillus niger on Feed Raw Material of Tilapia (Oreochromis niloticus). *Jurnal Perikanan Dan Kelautan*, *8*(1), 79–87. https://doi.org/10.33512/JPK.V8I1.3793

Indah, A. S., Permana, I. G., & Despal, D. (2020). Model Pendugaan Total Digestible Nutrient (TDN) pada Hijauan Pakan Tropis menggunakan Komposisi Nutrien. *Sains Peternakan*, *18*(1), 38. https://doi.org/10.20961/SAINSPET.V18I1.35684

Malianti, L., Sulistiyowati, E., Fenita, Y., Pascasarjana, P., Sumber, P., Alam, D., … Bengkulu, U. (2019). Profil Asam Amino Dan Nutrien Limbah Biji Durian (Durio Zibethinus Murr) Yang Difermentasi Dengan Ragi Tape (Saccharomyces Cerevisiae) Dan Ragi Tempe (Rhizopus Oligosporus). *Naturalis: Jurnal Penelitian Pengelolaan Sumber Daya Alam Dan Lingkungan*, *8*(1), 59–66. https://doi.org/10.31186/NATURALIS.8.1.9167

Manson, S., Campera, M., Hedger, K., Ahmad, N., Adinda, E., Nijman, V., & Nekaris, K. A. I. (2022). The effectiveness of a biopesticide in the reduction of coffee berry borers in coffee plants. *Crop Protection*, *161*, 106075. https://doi.org/10.1016/J.CROPRO.2022.106075

Mila, J. R., & Sudarma, I. M. A. (2021). Analisis Kandungan Nutrisi Dedak Padi sebagai Pakan Ternak dan Pendapatan Usaha Penggilingan Padi di Umalulu, Kabupaten Sumba Timur. *Bulletin of Tropical Animal Science*, *2*(2), 90–97. https://doi.org/10.31186/BPT.2.2.90-97

Nurhaita, N., Definiati, N., & Suliasih, S. (2016). Pemanfaatan Limbah Pelepah Sawit Sebagai Pakan Ternak Sapi Pada Kelompok Pemuda Tani Tunas Muda. *Dharma Raflesia : Jurnal Ilmiah Pengembangan Dan Penerapan IPTEKS*, *14*(1).

https://doi.org/10.33369/DR.V14I1.4282

Robbani, A. A., Ariyanti, O., Calvin, D., Mujiono, Sutarjo, G. A., Handajani, H., & Andriawan, S. (2022). The combination of tofu dregs and Rhodopsudomonas palustris on Oreochromis niloticus growth performances. *AACL Bioflux*, *15*(4), 2113–2124.

Sukria, H. A., & Krisnan, R. (2009). *Sumber dan Ketersediaan Bahan Baku Pakan di Indonesia*.

Surianti, S., Hasrianti, H., Wahyudi, W., & Irwan, M. (2021). Effect of fermented rice bran flour in artificial feed on survival rate and feed conversion ratio of tilapia, Oreochromis niloticus (Linnaeus, 1758). *Jurnal Iktiologi Indonesia*, *21*(3), 267–276. https://doi.org/10.32491/JII.V21I3.591

Suryani, Y., Hernaman, I., & Neng, H. H. (2017). Pengaruh Tingkat Penggunaan EM4 (Effective Microorganisms-4) pada Fermentasi Limbah Padat Bioetanol Terhadap Kandungan Protein dan Serat Kasar. *Jurnal istek*, *10*(1).