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Analysis of the Feasibility of Tiger Prawn and Finfish Polyculture Business Using Land with Different Ownership Status in The Coastal Area of Pinrang Regency

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Abstract

The objective of this research was to assess the financial feasibility of tiger prawn polyculture (*Penaeus monodon*) with finfish (milkfish, tilapia, and white snapper) using a leased land system and privately owned land. The sample of respondents was determined by purposive sampling technique in which the number of respondents each was 34 people for privately owned land and leased land. The primary data were collected through direct interviews with respondents. To determine the variations in financial feasibility parameters between the two polyculture cultivation systems, the data were examined using quantitative descriptive analysis, business financial analysis, and a t-test. The results showed that the polyculture business of tiger prawns and finfish using privately owned land with leased land had a significant difference in the income parameters, R/C ratio, and return on investment (ROI) and was not significantly different for the payback period (PP) parameter. The average value of the parameters of the financial feasibility analysis are: income of Rp. 7.043.771/year, R/C ratio of 1,44, PP of 4 years 1 month, ROI of 40,97%, NPV of Rp. 35.375.216, IRR of 77.32%, Net B/C 2,98 for privately owned land systems and income of Rp. 4.007.466/year, R/C ratio of 1,28, PP of 4 years 10 months, ROI of 24,88%, NPV of Rp. 21.492.203, IRR of 50,36%, Net B/C 2,12 for leased land system. Financially, the cultivation system on private land is more profitable than the polyculture cultivation system on leased land. However, in general, both polyculture cultivation systems are profitable and feasible to be continued and developed.

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Finfish;
financial feasibility;
polyculture;
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Introduction

Aquaculture is one type of sector that contributed about 50 percent of the world's total fishery production in 2018 with a production growth rate of more than 500% since the 1990s (FAO, 2020). One model of cultivation is polyculture. In order to make the most use of the available resources, polyculture is founded on the premise that each species that is stocked has its own feeding niche (Anil *et al*. 2010). Based on the concepts of agroecology and aquaculture ecology, the polyculture system is concerned with increasing land productivity, environmental conservation, and animal welfare. Efficient polyculture supports synergies between species to obtain optimal productivity (Thomas *et al*., 2020). In line with this, in 2020 the Fisheries and Marine Service of Pinrang Regency recorded an increasing trend

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of shrimp and fish from polyculture cultivation in the last 5 years. The data showed an increase in production yields of 6%-15% for tiger prawns and 10%-25% for milkfish.

A promising brackish-water aquaculture, shrimp farming offers a high rate of return on investment during a brief development time. For shrimp to grow and produce more, technological advancements in polyculture with other aquaculture biota are required. Some types of finfish that are commonly cultivated together with tiger prawns are tilapia and milkfish. In 2018, KKP through the Directorate General of Aquaculture introduced white snapper (Lates calcalifer Bloch, 1790) or known locally as *bale kanja* as a new type of finfish that can be polycultured with tiger prawns. Fish with a smooth flesh texture, white flesh without melanin, and few spines make barramundi very popular, and have high market prospects and prices (Irmawati *et al*. 2021).

South Sulawesi's tiger shrimp production is expected to reach 12 million heads in 2020 (Marine and Fisheries Department of South Sulawesi, 2020). Pinrang Regency is the major tiger shrimp production region in South Sulawesi and one of the top regions for tiger shrimp production. The total potential area of ponds in Pinrang Regency is ±15,853 ha or 16,51% of the total ponds in South Sulawesi. This is what makes Pinrang Regency designated as the center for the development of tiger shrimp production in South Sulawesi. The majority of pond cultivators in Pinrang Regency manage ponds traditionally with a polyculture system. Cultivation with a polyculture system is intended to optimize ponds by compaction in order to provide greater income for pond entrepreneurs.

In research conducted by Islamiyah (2020), polyculture actors of milkfish, tiger shrimp, and seaweed in Bonto Langkasa Village, Minasatene Sub-District, Pangkajene Regency earned an income of Rp. 24.093.532,-/year and the business was concluded to be feasible with the net present value. (NPV) was positive, the net benefit-cost ratio (Net B/C Ratio) was more than 1, the internal rate of return (IRR) was greater than the interest rate, and the payback period (PP) was 3,2 years.

In the Pinrang Regency region, it is unknown with certainty how much money will be made or how feasible polyculture ponds will be. Since they neglect the financial component, cultivators are unable to assess the feasibility of their farming efforts. In order to provide pond farmers, relevant agencies, and institutions that support people's efforts to accelerate economic development with information, researchers are encouraged by these issues to learn more clearly.

Materials and Methods

Research Location and Time

The study was conducted from March to June 2021 in Lanrisang and Mattirosompe sub-districts, Pinrang district, South Sulawesi. Purposefully, this area was chosen because it is a hub for tiger shrimp development in South Sulawesi, particularly for polyculture system farming.

Research Location and Time

The research used survey research methods (interviews, observations, and literature studies) (Singarimbun and Effendi, 2006). Sampling technique was done by conducting cluster sampling. According to Sedgwick (2014), cluster sampling involves taking random cluster samples from the population, with all members of each selected cluster invited to participate and a sampling frame is required that includes all clusters in the population. The sample is then selected at random from the framework that has been made. Each cluster has the same

probability of being selected, regardless of the others.

The number of respondents for polyculture businesses that use private and rented land are 34 people so that the total number of respondents in this study is 68 people. Respondents are farmers who are actively engaged in the polyculture aquaculture industry, which is one of the factors taken into account.

Types of Data and Source of Data

The data obtained were primary data (respondents) and secondary data (relevant agencies and institutions). Secondary data were obtained from the Marine Affairs and Fisheries Department (DKP) of Pinrang Regency and related literature data. Primary data were obtained through direct interviews with cultivators who became respondents, namely by using a list of questions (questionnaires). Primary data collected from respondents were production results, labor, investment costs, operational costs, and production value. Secondary data collected included the production and productivity of shrimp and fish in Pinrang Regency.

Data Analysis

The data analysis used in this research was quantitative descriptive analysis and financial feasibility analysis. Descriptive analysis is an analysis used to describe the results of observations in accordance with the reality in the field regarding something being studied. Tables and graphs will be used to present all of the analysis's data. Financial feasibility analysis includes:

Business Analysis

According to Febrianto (2008), the components used in conducting business analysis include production costs, business revenues and income derived from fishery businesses. The business analysis consists of revenue and cost balance analysis, payback period (PP) analysis and return of investment (ROI) analysis. After analyzing several parameters, the test was continued with a t-test to see the differences that exist in polyculture businesses that use private land and polyculture businesses that use leased land.

Income Analysis

Income analysis aims to determine the amount of profit obtained from a business activity carried out. Business income in the development of aquaculture can be calculated using the following equation (Siang and Aziz, 2010):

$$\boldsymbol{\Pi = TR - TC} \quad \textbf{..... (1)}$$

Note:
П = profit
TR = total revenue
TC = total cost
With business criteria:
TR > TC : Profitable business
TR < TC : Business suffers a loss
TR = TC : Work at the break-even point

Analysis of the balance of revenue-cost ratio

This analysis aims to determine how far each rupiah value of costs used in business activities can provide a number of revenue values as benefits. The formula used to calculate R/C is the equation (Darsono, 2008):

$$\boldsymbol{R/C\ Ratio = \frac{TR}{TC}} \text{ ..... (2)}$$

With criteria:
R/C > 1, Profitable business
R/C < 1, Business suffers a loss
R/C = 1, At the break-even point

Payback Period (PP) Analysis

According to Umar (2003), Payback Period (PP) is a period required to recoup investment spending using cash flows. payback period (PP) as the ratio between investment expenditures and profits which result in units of time. PP calculation is done by the formula:

$$\boldsymbol{PP = \frac{Investment\ value}{Profit} \times 1\ year} \text{ ..... (3)}$$

Analysis of Return of Investment (ROI)

Return on investment (ROI) is the ability of the capital invested in all activities to generate a net profit. The formula used to calculate ROI is the equation (Sutrisno, 2001):

$$\boldsymbol{ROI = \frac{Profit}{Investation} \times 100\%} \text{ ..... (4)}$$

Analysis of Investment

In addition to business analysis, the feasibility of a business can be seen using an investment feasibility analysis. The measuring instruments used include Net Present Value (NPV), Internal Rate of Return (IRR), and Net Benefit Cost Ratio (Net B/C). This activity is carried out to assess the extent of the benefits that can be obtained in carrying out a business activity. With this feasibility analysis, it is hoped that the risk of failure in polyculture shrimp and fish cultivation at the research site can be avoided. According to Thomas (2017), the best practice for investment analysis is to use standard cost categories. Standard categories allow manufacturers to more easily identify common costs across their operations.

Net Present Value (NPV)

The net present value is used to assess the benefits of the investment, namely what is the present value of the net benefits of the project expressed in rupiah. The project is declared feasible to continue if the NPV>0, while if the NPV<0, then the investment is declared unprofitable which means the project is not feasible to be implemented. If the NPV value = 0 means that the project only returns capital or no profit and no loss, Kadariah *et al*. (1999). The formula used to calculate NPV is the equation according to Gittinger (1982):

$$NPV = \sum_{t=1}^{n} \frac{Bt-Ct}{(1+r)t} \quad \text{..... (5)}$$

Note:
Bt : Benefit of year *t*
Ct : Cost of year *t*
r : *Discount rate*
t : Year
n : Project life
Indicators:
1. NPV > 0 (positive), the business is feasible to carry out,
2. NPV < 0 (negative), the business is not feasible to carry out.

Net Benefit-Cost Ratio (Net B/C)

According to Kadariah *et al*. (1999), Net Benefit-Cost Ratio (Net B/C) is the ratio between the present value of net profit in years where net profit is positive and net profit is negative. The formula used is:

$$Net\ B/C = \frac{\sum_{t=1}^{n} \frac{Bt-Ct}{(1+i)t}(Bt-Ct)>0}{\sum_{t=1}^{n} \frac{Bt-Ct}{(1+i)t}(Bt-Ct)<0} \quad \text{..... (6)}$$

With feasiblity criteria:
B/C > 1, means the business is worth running
B/C < 1, means the business is not worth running
B/C = 1, means the implementation decision depends on the investor

Internal Rate of Return (IRR)

The internal rate of return is the value of the interest rate i that makes the NPV of the project equal to zero. IRR can be defined as the interest rate at which the present value of total costs is equal to the present value of total revenues. IRR is also considered as the rate of net return on investment, where a positive net benefit is reinvested in the following year and earns the same rate of return and is given interest for the remaining life of the project. IRR can be formulated as follows:

$$IRR = i1 + \frac{NPV1}{NPV1-NPV2}(i2 - i1) \quad \text{..... (7)}$$

Note:
NPV1 = NPV that is still positive
NPV2 = negative NPV
i1 = discount rate that still gives a positive NPV
i2 = discount rate that gives a negative NPV
Indicators:
1. IRR > the prevailing interest rate, then the business is declared feasible
2. IRR < the prevailing interest rate, then the business is declared unfeasible

Results and Discussion

Polyculture Cultivation Business Potential

The adoption of polyculture cultivation business is one sort of business in the fisheries industry that aims to improve production outcomes, revenue, and profits. The basic objective of business players is to make money, either directly or indirectly, so that their enterprise can develop and grow. This is in line with the economics of running a business principle, which is to maximize profit at the lowest possible cost.

The polyculture activity of tiger prawns with finfish in Pinrang Regency is carried out throughout the year with one to two growing seasons. In the third month (12th week) after the first stocking, the farmers do partial harvest of tiger prawns one to two times per month. And so on until the sixth month (end of the first cycle). Milkfish harvest is carried out at week 14 and at week 16 farmers start harvesting barramundi, with a success rate of 60% to 75%.

Cultivation Land Ownership Status

The area of land owned by milkfish and tiger shrimp cultivators is on average between 1-5 hectares. Cultivators who manage their own land are cultivators who have been running their business for generations. Meanwhile, cultivators who run polyculture businesses with leased land status, rent land from the local government or from land owners at a rental price of 6-7.5 million/hectare for 1 year. Vanderpuye *et al*. (2020) states that there are several forms of ownership status, namely:

1. Joint assets where there are joint assets that are owned, managed and controlled by joint owners, such as groups or associations of individuals. Due to this form of joint ownership of property, individuals can resolve and manage conflicts through mutual benefit and enforcement of responsibilities.
2. Public property can also be referred to as state property which is generally owned, managed, and controlled by the government of that country.
3. Individual or private property describes the rights of access, use and management of individual property.

Investment Cost

The investment cost incurred by finfish-shrimp farmers on an area of ±1 ha per year is Rp19,357,330,- for business on private land and Rp18,729,526,- for land lease system business. The amount of investment cost used in the two criteria does not show a significant difference. In detail, the differences in the structure of investment costs can be seen in Table 1. Champo & Zuniga-Jara (2017) stated that the capital costs in aquaculture generally vary in the range of 10%-15% depending on the project risk (higher in offshore projects).

Table 1. Investment Component

No	Description	Unit	Total	Private Land			Leased Land		
				Asset's Useful Lifw (year)	Total Cost (Rp)	Shrinkage /year (Rp)	Asset's Useful Lifw (year)	Total Cost (Rp)	Shrinkage /year (Rp)
1	Guard house/warehouse	Unit	1	6,2	5.195.238	843.557	4,3	1.814.079	418.750
2	Operational motorcycle	Unit	1	8,0	7.119.048	891.650	10,5	8.041.516	766.781
3	Water pump machine	Unit	1	2,7	2.678.333	992.559	3,6	3.038.087	841.550
4	Sluice	set	1	4,7	1.025.397	218.983	6,2	1.148.014	185.965
5	Net	set	1	1,6	441.270	272.549	2,2	533.394	246.250
6	Scale	set	1	2,5	657.937	264.013	3,3	884.477	270.718
7	Fishing nets	Unit	1	1,9	279.619	150.564	2,4	331.119	135.881
8	Fish trap	Unit	1	1,5	297.540	203.750	1,9	351.444	180.278
9	Fish chart	Unit	1	1,4	365.508	267.756	1,8	362.274	198.713
10	Initial working capital	Ls	1		1.297.441			2.054.122	
	Total Investasi				**19.357.330**	**4.105.380**		**18.558.526**	**3.244.887**

Fixed Costs and Variable Costs

Fixed cost components for polyculture cultivation consist of maintenance costs, land rental costs, taxes and levies and annual depreciation of investment costs. The use of fixed costs for polyculture cultivation on leased land is greater than for polyculture cultivation on private land, this is because cultivators have to pay land rent at the beginning of the season before carrying out production activities. Details of the fixed costs required for one year are shown in Table 2.

The use of costs in this business is not only fixed costs but also variable costs. Variable costs are incurred when farmers carry out shrimp and fish production activities. The difference in the amount of cost used between businesses on privately owned land and leased land can be seen from the number of stockings and types of biota that are stocked. Land owners generally carry out production activities by prioritizing shrimp over fish. Meanwhile, land cultivators optimize land by prioritizing fish production. This is done because land cultivators have to create a relatively faster cash flow. The difference in total expenditure used is ±3-4 million per year for a 1 ha pond. The details of the variable cost components for a period of one year are shown in Table 2.

Table 2. Components of Fixed Costs and Variable Cost

No	Description	Unit	Private Land		Leased Land	
			Quantity	Annual Cost (Rp)	Quantity	Annual Cost (Rp)
	A. Fixed Cost					
1	Investment depreciation cost	Ls	1	4.105.380	1	3.244.887
2	Maintenence cost	Ls	0,05	902.994	0,05	825.220
3	Taxes & levies	ha	1	95.882	1	95.000
4	Land lease	ha	1	-	1	6.690.000
	Total Fixed Cost			**5.104.257**		**10.855.107**
	B. Variable Cost					
1	Preparatory work wages	ha	1	161.765	1	126.250
2	Maintenance work wages	Ls	1	3.426.471	1	3.225.000
3	Harvest work wages	ha	1	1.058.699	1	879.853
4	Lime procurement cost	kg/ha	424	850.642	295	574.675
5	Fertilizer procurement cost	kg/ha	453	731.415	400	678.500
6	Seed procurement cost	ha	1	3.599.438	1	2.443.122
7	Probiotic procurement cost	liter/ha	17	161.207	15	194.625
8	Fuel Cost	liter/ha	380	2.660.000	380	2.660.000
9	Packing & Freight	Ls	1	1.000.000	1	1.000.000
	Total Variable Cost			**13.649.636**		**11.782.025**
	Total Cost (Expense)			**18.753.893**		**22.637.132**

Table 2 shows that the total value of fixed costs in both land ownership statuses is lower than the total value of variable costs in both land ownership statuses. According to research by Miqdad *et al*. (2020) on fish farming land in Muthanna, the total costs incurred for variable costs show a larger percentage compared to fixed costs of 60,78%, while the percentage of fixed costs is only amounting to 39,22% which indicates that variable costs are the largest part of the total costs needed in cultivation, so efforts need to be made to minimize the costs that come through the low cost of one or all variable cost items.

Table 3. Average of Production Results and Annual Revenues

No	Commodities	Private Land				Leased Land		
		Price/kg (Rp)	SR (%)	Harvest (kg)	Total (Rp)	SR (%)	Harvest (kg)	Total (Rp)
1	Tiger prawn	75.000	17	182	13.617.353	17	145,2	10.887.353
2	Milkfish	18.000	80	448	8.055.000	80	818,5	14.733.529
3	White snapper	50.000	21	99	4.937.500		-	-
4	Tilapia	28.000	55	138	3.850.000	50	125,0	3.500.000
	Total Sales				**30.459.853**			**29.120.882**

Business Analysis

The results of the income analysis for polyculture pond cultivation with an average area of ±1 ha per year indicate that this activity provides benefits. This can be seen from the total revenue obtained is greater than the costs incurred. The total revenue of polyculture pond cultivation per year is Rp. 30.459.853,- for privately owned land and Rp. 29.120.882,- for leased land. Details of the comparison of production results and total revenues can be seen in Table 3. According to Erwiantono *et al*. (2020), the practice of polyculture has the potential to provide a lucrative business, leading to increased income and poverty alleviation for small-scale farmers.

Table 4. Analysis of financial feasibility of tiger prawns-finfish polyculture culture in Pinrang Regency, South Sulawesi

	Financial feasibility analysis	Unit	Polyculture farming		*T- Test*
			Private Land	Leased Land	
A	Business Analysis				
	Income	*Rp*	7043771 ± 604927	4007466 ± 165692	0,000 (s)
	R/C Ratio		1,4426 ± 0,0395	1,1856 ± 0,0088	0,000 (s)
	PP	*Year*	4,13 ± 0,49	4,85 ± 0,34	0,235 (ns)
	ROI		0,4097 ± 0,0490	0,2488 ± 0,0196	0,004 (s)
B	Investment Analysis				
	NPV	*Rp*	38.375.216	20.778.485	-
	IRR	*%*	77,32	50,36	-
	Net B/C Ratio		2,98	2,12	-

Note : s = significantly different between private land and leased land
ns = not significantly different between private land and leased land

The level of income calculated through the t-test shows a significant difference between the income level of polyculture cultivation using privately owned land and leased land. The income of polyculture cultivation using privately owned land is greater than the income of farmers using leased land. The amount of income obtained on average is Rp. 7.043.771,-/year for private land and Rp. 4.007.466,-/year for leased land. The amount of profit earned by cultivators is determined by the amount of shrimp and fish production and the selling price in the market. This amount of production is influenced by the survival rate (SR) of the cultured cultivar which is obtained from the calculation of the number of fish harvested compared to those stocked.

The R/C ratio of polyculture businesses that use private land is greater than the R/C ratio of leased land. The average value obtained is 1,44 and 1,18, respectively. That is, every Rp. 1,- the total costs incurred will result in a total revenue of Rp. 1,44,- polyculture cultivation

on private land and Rp. 1,18,- polyculture cultivation business with a rental land system. Both systems of polyculture cultivation are feasible because the resulting value is greater than 1 (one). In a study conducted by Khairini *et al*. (2021), the R/C value of the polyculture system between fish, shrimp, and crab is 1.73, which means that each additional input of 1 will produce an output of 1,73.

The test results for the payback period do not show a significant difference. The average time needed to return the investment costs for polyculture cultivation businesses using both privately owned land and leased land is ± 4 years. However, this value is included in the good category because the payback period is less than 5 years. This is in line with the opinion of Umar (2007), the rate of return on capital is categorized as fast if the PP value is <5 years, while it is slow if the PP value is >5 years. The faster the return on investment costs of a project, the better the project because the smoother the turnover of capital (Ibrahim, 2003).

The percentage of the ability of the invested capital to generate a net profit (Return of investment) based on the test results shows a significant difference. The average ROI value for businesses that use private land is greater than polyculture businesses with leased land. The average level of capital ability to generate net profit on each criterion is 40,97% for private land and 24,88% for leased land. This value is the optimal value and shows that this effort is feasible. Based on the results of research Israel *et al*. (1985), in polyculture systems between shrimp (*Penaeus monodon*) and milkfish (*Chanos chanos*), the ROI values ranged from 8 to 85% and the payback period from 1,1 to 10,5 years.

Based on the results of the business analysis presented in Table 4, it shows that the polyculture shrimp farming business with finfish, both using privately owned land and leased land in Lanrisang and Mattirosome subdistricts are included in the criteria for development.

Analysis of Investment

Based on the results of the feasibility analysis of the NPV value of polyculture cultivation at the research site, it shows that these business activities will provide a value benefit of Rp. 38.375.216,- for polyculture cultivation on private land and Rp. 20.778.485,- for the cultivation business of the rental land system, for 5 (five) years of investment period with a discount rate of 12% per year. Based on these results, the NPV value is positive because it is more than zero, this indicates that the cultivation business is feasible to be continued or developed. The following graph will show the difference in NVP and IRR values between polyculture cultivation on private land and polyculture cultivation on leased land systems.

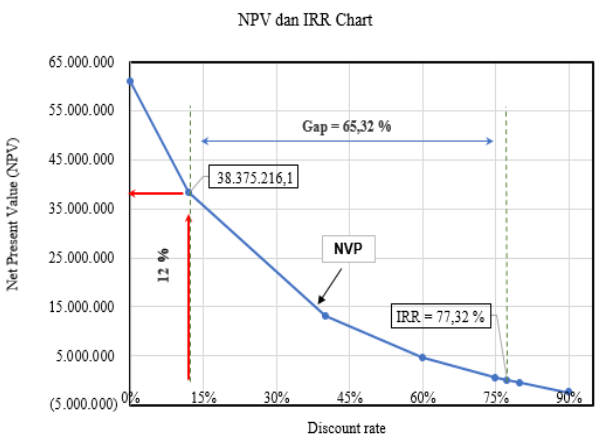

Figure 1. Private Land

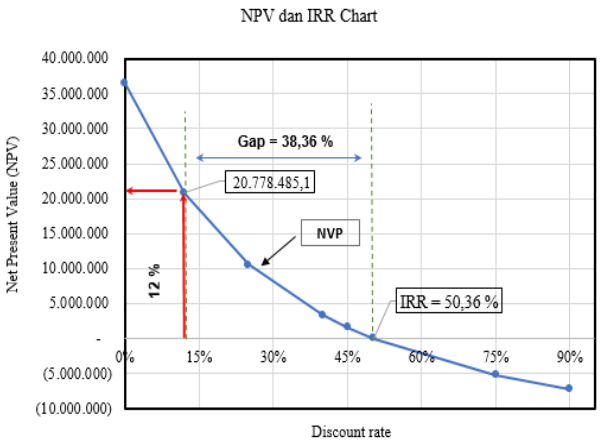

Figure 2. Leased Land

In the IRR feasibility test, the value of polyculture cultivation at the study site is greater than the discount rate target of 12%. The results obtained were 77,32% for polyculture cultivation on private land and 50,36% for cultivation with leased land systems. These two results indicate that the cultivation business provides good benefits and returns from the value of the investment invested. This is also supported by the Net B/C value of each criterion, namely 2,98 for polyculture cultivation on private land and 2,12 for cultivation of leased land systems. This means that the investment business is feasible because the Net B/C value is greater than 1 (one).

Overall, the results of the business analysis and the results of the investment analysis show that polyculture cultivation using privately owned and leased land is still feasible in Pinrang Regency. If the actual conditions in the field are in accordance with the assumptions, then this is included in the good category for the parameters of the financial feasibility analysis.

Conclusions

The tiger shrimp polyculture with finfish systems business operations on owned land and leased land in Pinrang Regency demonstrate notable variances in terms of income, R/C ratio, and ROI. Although there is no difference between private land systems and leased land, the payback period (PP) is still within the ideal range.

Businesses engaged in polyculture agriculture that employ private land benefit more than those that use leased land based on the metrics of NVP, IRR, and Net B/C ratio. However, the two polyculture cultivation systems used in Pinrang Regency offer advantages to business actors and unquestionably show that the enterprise is highly likely to be continued or expanded.

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