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Analysis of fishermen's economic welfare in Pinrang regency, South Sulawesi: Integrating institutional empowerment, infrastructure development, and productivity for sustainable livelihoods

Suharwan Hamzah[1*], Maryunani[2], Multifiah[3], Dias Satria[4]
[1]Economics Department, Faculty of Economics and Business, Hasanuddin University, Indonesia; suharwanhamzah@fe.unhas.ac.id (S.H.)
[1,2,3,4]Economics Department, Faculty of Economics and Business, Brawijaya University, Indonesia; maryunani@ub.ac.id (M.) multifiah@ub.ac.id (M.) dias.satria@ub.ac.id (D.S.).

Abstract: This research analyzes the factors that can influence the economic welfare of fishermen in Pinrang Regency, South Sulawesi, focusing on the integration of institutional empowerment, infrastructure development, and productivity for sustainable livelihoods. It employs a quantitative research approach, collecting primary data from 95 respondents using a questionnaire. The research variables include institutional empowerment, fishermen empowerment, infrastructure, productivity, and welfare, with data analyzed using Structural Equation Modeling (SEM-PLS). The findings indicate that institutional empowerment and infrastructure development significantly affect fishermen's productivity, which in turn positively impacts their welfare. However, fishermen empowerment did not show a significant impact on fishermen's productivity. The study concludes that a holistic approach, integrating these key factors, is essential to improve the economic welfare of fishermen in Pinrang Regency. Recommendations for local governments include strengthening institutions, improving infrastructure, and promoting sustainable fishing practices to achieve long-term improvements in fishermen's welfare.

Keywords: *Fishermen's economic welfare, Institutional empowerment, Infrastructure development, Fishermen's productivity, Sustainable livelihoods in Pinrang South Sulawesi.*

1. Introduction

The welfare of fishermen is one of the crucial issues in coastal areas globally, where fishing remains the main source of livelihood for fishermen even though it is faced with many challenges. Pinrang Regency, is one of the regencies located in South Sulawesi - Indonesia which has significant regional potential in the fisheries sector, especially capture fisheries, which are the backbone of the local of economy in that area [1]. The number of people working based on the main type of activity in Pinrang Regency can be seen in the following table 1. Based on table 1 its shows that the number of people working based on the type of main activity that is highest in Pinrang Regency is in the agricultural, forestry, and fisheries fields with 47,559 people or 41.9 percent (men as many as 33,867 people and women as many as 13,692). Furthermore, in the community service field with a total of 23,676 people or 20.9 percent. While the number of people working in the lowest field of work/sector is in the processing industry with a total of 6,551 people or 5.8 percent. This shows that the agricultural, forestry, and fisheries sectors are still the mainstay of hope for residents to get jobs in Pinrang Regency. Although the potential and marine resources in Pinrang Regency are abundant and production continues to increase, the economic welfare of fishermen in this area is still not optimal [2, 3]. Several constraining factors include limited infrastructure, low technology adoption, insufficient capital, and a weak institutional framework [4].

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* Correspondence: suharwanhamzah@fe.unhas.ac.id

The aim of this research is to examine the factors that impact the economic welfare of fishermen in Pinrang Regency, with a focus on the integration of institutional empowerment, infrastructure development, and productivity to achieve sustainable livelihoods [5, 6]. As an archipelagic nation, Indonesia boasts vast marine and coastal resources that serve as the backbone of its economic development. The advancement of fisheries, as part of marine development, is centered on efforts to enhance the income and living standards of fishermen, improve the well-being of coastal communities, fulfill food and nutritional needs, supply raw materials for industries, boost exports, and create employment and business opportunities. The fisheries and marine sector are a key priority for national development and is expected to drive economic growth in Indonesia.

Table 1.
Population Aged 15 Years and Over by Main Activity in Pinrang Regency in 2022.

No.	Main Employment Field	Man	Female	Quantity	(%)
1	Agriculture, forestry, fisheries	33.867	13.692	47.559	41,9
2	Processing industry	3.924	2.627	6.551	5,8
3	Trading, eating house, restaurant	7.481	12.724	20.205	17,8
4	Community services	10.548	13.128	23.676	20,9
5	Other	13.436	2.046	15.482	13,6
Amount		69.256	44.217	113.473	100

Source: Badan Pusat Statistik Kabupaten Pinrang [7].

The objective of Indonesia's national development is to enhance the welfare of its people, advance the nation's quality of life, and safeguard the entirety of Indonesia's territory [8, 9]. The fisheries sector has great potential for economic growth, employment and poverty reduction [3]. Despite this potential, many fishermen are still in poverty, where their livelihoods are highly dependent on unpredictable seasons and catches, and are characterized by low productivity and outdated fishing practices [10, 11]. In South Sulawesi, especially in Pinrang, fishing activities are still dominated by traditional methods that limit the scope of economic progress. One important element to improve welfare for fishermen lies in how to handle institutional constraints that hinder access to financing, modern fishing technology, and markets. Weak institutions, both formal and informal, will limit the ability of fishermen to utilize their resources effectively and optimally. The conditions in Pinrang Regency in terms of institutions such as government institutions, cooperatives, and local organizations are still underdeveloped. Be'le [12] thus, hampering fishermen's ability to access the equipment and resources needed to increase their productivity. Apart from that, another obstacle is the lack of adequate infrastructure, including fish landing ports, cold storage facilities, and fish markets, limiting fishermen's ability to optimize catches and connect with larger markets, thereby reducing their income potential. In the effort to enhance the welfare of fishermen, the connection between structural challenges and their well-being is examined from the perspective of sustainable livelihoods, which takes into account not only economic factors but also social and environmental aspects. Empowering fishermen through skill development, financial assistance, and access to technology can boost productivity and, consequently, ensure income stability.

The importance of this research is for a comprehensive analysis of institutional, infrastructure and productivity related factors that influence the welfare of fishermen in Pinrang Regency. By integrating these elements, this study aims to provide insight and actionable input on how local governance, institutional performance improvements, and infrastructure improvements so that communities, especially fishermen, can produce more sustainable livelihoods for fishermen in the Pinrang Regency area of South Sulawesi. In the end, the findings of this study can help shape strategies that enhance the welfare of coastal communities while preserving the sustainability of marine resources for future generations.

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2. Literature Review

2.1. Catch Fisheries

According to Law No. 45 of 2009 Langford, et al. [11] fisheries refer to activities related to the management and utilization of fish resources and their environment, encompassing all stages from pre-production, production, and processing to marketing, conducted within a fisheries business. Meanwhile, fishing (capture fisheries) is the activity of harvesting fish from waters that are not being cultivated by any means, including activities involving the use of vessels for loading, transporting, storing, chilling, handling, processing, and/or preserving the fish. This definition clearly shows that the intended fishing activity is the aim of obtaining profit both financially, and to obtain other added value such as, absorption of labor, fulfillment of the need for animal protein, foreign exchange and other regional income [13].

2.2. Fishing Community

Geographically according to Kusnadi, et al. [14]. The fishing community is a group of people who live, grow and develop in a coastal area or beach, which is a border area between land and sea where most of the people's livelihoods are through fishing from the sea, both direct fishing and cultivation. They live close to their livelihood location, where they often face very complex social and economic problems in their daily lives.

2.3. Fishermen's Economy

Fisherman's economy is an economic activity carried out by fishermen in catching fish and other marine commodities. Fishermen play a crucial role in the local economy, particularly in coastal and fishing communities [15]. Fishermen are a group of people in a low socio-economic scale. Usually the pattern of life in fishing does not pay attention to the sustainability of fishery resources. This is because they do not know about formal fishery education and do not have special skills in the field of processing fishery products so they need training related to fisheries, both fishing patterns and exploitation of fishery products that pay attention to the sustainability of fishery resources. Likewise, it is needed mastery of technology and market networks, so that their catch can be sold with the expected results according to market price conditions [16].

2.4. Institutional Concept

Institutions are related to the issue of governance of the rules of the game so that exchanges between economic actors can take place, both cooperation and competition [17, 18]. Institutions provide breath and space for the growth and development of an organization, because institutions are also rules that are known, followed and enforced properly to provide protection and obstacles for individuals and members of society [19, 20]. Institutional factors play an important role because they are closely related to people's welfare due to the existence of rules in achieving the expected goals. Institutions do not have to be equated with government institutions, traditional customary institutions are more effective in binding the community, because in informal institutions there is a system of willingness from its members. Fisheries institutions are very much needed to solve various fisheries management issues so far.

2.5. Empowerment of Fishermen

The concept of empowerment is very important as a development strategy that is based on resources owned by individuals, is direct, democratic and social learning through direct experience.. [21, 22]. This concept exists due to the failure in a process and implementation of socio-economic development that tends to be very centralistic. This failure is related to the reduced direct opportunities for the community to be directly involved in an ongoing development process, especially in terms of making decisions regarding the planning, implementation and evaluation of socio-economic

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development programs.

3. Methods

3.1. Data Types, Population and Samples

This research employs a quantitative research approach, which involves gathering extensive data from selected respondents and processing it into numerical and statistical forms [23, 24]. The data used in this study is primary data, collected through questionnaires distributed online. The sample consists of 95 individuals.

3.2. Research Variables

Research variables are any elements or factors identified by the researcher for study in order to gather information, which can then be used to draw conclusions [25, 26]. The research variables employed in this study are derived from theoretical concepts, as explained below.

Table 2.
Research Variable Indicators.

Research Variables	Research Indicators
Institutional strengthening (X1),	• Fishermen's organization aspect (X1.1); • Microfinance institution aspect (X1.2); • Government institution aspect (X1.3).
Fishermen's empowerment (X2)	• Extension provision aspect (X2.1) • Training implementation aspect (X2.2) • Assistance implementation aspect (X2.3).
Infrastructure (X3)	• Traditional market aspect (X3.1) • Fuel filling center aspect (X3.2) • Ice factory aspect (X3.3)
Fishermen's productivity (Y1)	• Fishing gear aspect (Y1.1) • Business capital aspect (Y1.2) • Business management aspect (Y1.3).
Fishermen's welfare (Y2),	• Fishermen's income aspect (Y2.1) • Housing condition aspect (Y2.2) • Health condition aspect (Y2.3)

3.3. Analysis Method

The data analysis method employed in this study is SEM-PLS, Figure 1 shows the factors used to examine the influence on improving the welfare of the capture fisheries community in Pinrang Regency. Structural Equation Modeling (SEM) is a set of techniques that enables the simultaneous testing of multiple dependent variables in relation to several independent variables [27].

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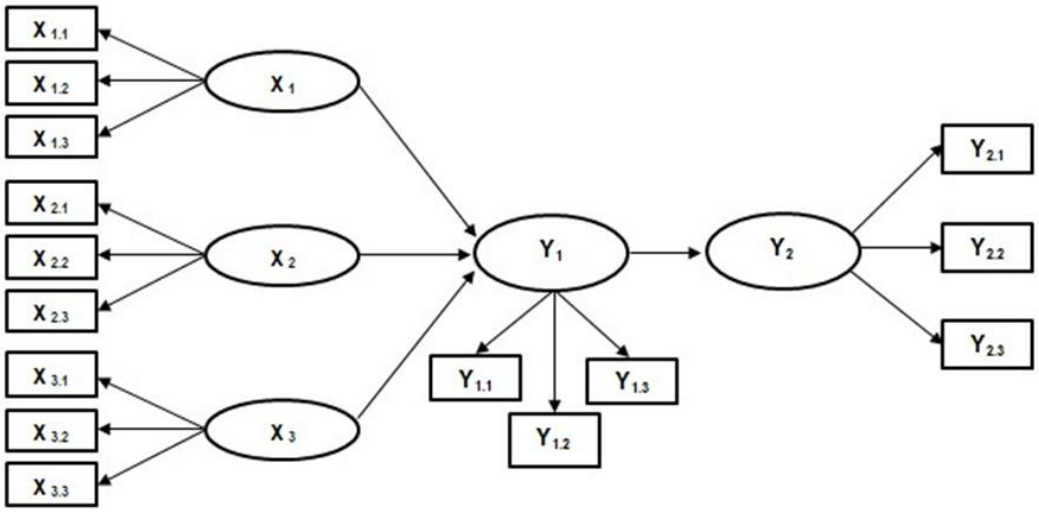

Figure 1.
Diagram of the structural relationship path between research variables.

4. Results and Discussion

4.1. Result

4.1.1. Results of Outer Model Evaluation

4.1.1.1. Discriminant Validity

The model demonstrates adequate discriminant validity if the square root of the Average Variance Extracted (AVE) for each construct exceeds the correlation between that construct and the other constructs. To assess the validity of a construct, the AVE value should be considered, with a model being considered good if the AVE of each construct is greater than 0.5. The EVA output results can be seen in table 3.

Table 3.
Output SmartPLS.

Variable	AVE (Average Variance Extracted)
Institutional Strengthening (X1)	0.649
Fishermen Empowerment (X2)	0.551
Infrastructure (X3)	0.764
Fishermen Productivity (Y1)	0.511
Fishermen Welfare (Y2)	0.736

4.2. Validities Discriminant

Discriminant validity is necessary to compare the Loading Factor value with the cross-loading value, where the expected value should be higher than the correlation with other constructs. The model exhibits good discriminant validity if the HTMT (Heterotrait-Monotrait Ratio) value is less than 0.90 [23]. The results of the discriminant validity test are as follows in table 4:

Table 4.
Discriminant Validity (Heteroit-Monotrait Ratio).

Variable	Fishermen Productivity (Y1)	Fishermen Welfare (Y2)	Institutional Strengthening (X1)	Fishermen Empowerment (X2)	Infrastructure (X3)
Fishermen Productivity (Y1)	-	0.756	0.671	0.767	0.574
Fishermen Welfare (Y2)	0.756	-	0.838	0.847	0.586
Institutional Strengthening (X1)	0.671	0.838	-	0.953	0.404
Fishermen Empowerment (X2)	0.767	0.847	0.953	-	0.718
Infrastructure (X3)	0.574	0.586	0.404	0.718	-

The results of the discriminant validity test in the table above indicate that each variable has an HTMT value of less than 0.90. Therefore, it can be concluded that the model satisfies the criteria for discriminant validity.

4.3. Composite Reliability

Composite reliability is a test of construct reliability performed to verify the accuracy, consistency, and precision of the instrument in measuring the construct. A latent variable or construct is considered reliable when its composite reliability value exceeds 0.7. Composite Reliability Output results in table 5.

Table 5.
Smart PLS Composite Reliability Output.

Variable	Composite Reliability
Institutional Strengthening (X1)	0.847
Fishermen Empowerment (X2)	0.783
Infrastructure (X3)	0.906
Fishermen Productivity (Y1)	0.737
Fishermen Welfare (Y2)	0.893

The Composite Reliability (rho_c) value of each latent variable is greater than 0.7 so it can be said that each latent variable meets composite reliability.

4.4. Inner Model Evaluation Results

4.4.1. Collinearity Statistics (VIF) Test

The collinearity statistics test is used to assess potential collinearity issues between constructs or latent variables by examining the VIF value of each latent variable and its indicators. If the VIF value is below 5, no collinearity problem exists, whereas a VIF value greater than 5 indicates a collinearity issue. Below is the Smart PLS output in Table 6.

Table 6.
Table of VIF Values.

Variable	Fishermen Productivity (Y1)	Fishermen Welfare (Y2)
Institutional Strengthening (X1)	2.198	-
Fishermen Empowerment (X2)	2.892	-
Infrastructure (X3)	1.486	-
Fishermen Productivity (Y1)	1.000	1.000

The VIF value for each latent variable and its indicators is below 5, indicating that there are no collinearity issues.

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4.5. R Square

The R Square value indicates the extent to which the independent variable can explain the variation in its dependent variable. A higher R Square value means that the independent variable is more effective in explaining its dependent variable in Table 7.

Table 7.
Table of R-Square Values.

Variable	R-Square
Fishermen Productivity (Y1)	0.526
Fishermen Welfare (Y2)	0.602

The R Square value for variable Y1 is 0.526, meaning that variables X1, X2, and X3 can explain 52.6% of the variation in Y1, while the remaining 47.4% is influenced by factors outside the model. The R Square value for variable Y2 is 0.602, indicating that variable Y1 can explain 60.2% of the variation in Y2, with the remaining 39.8% being attributed to other factors outside the model.

4.6. Path Coefficients (Hypothesis Testing)

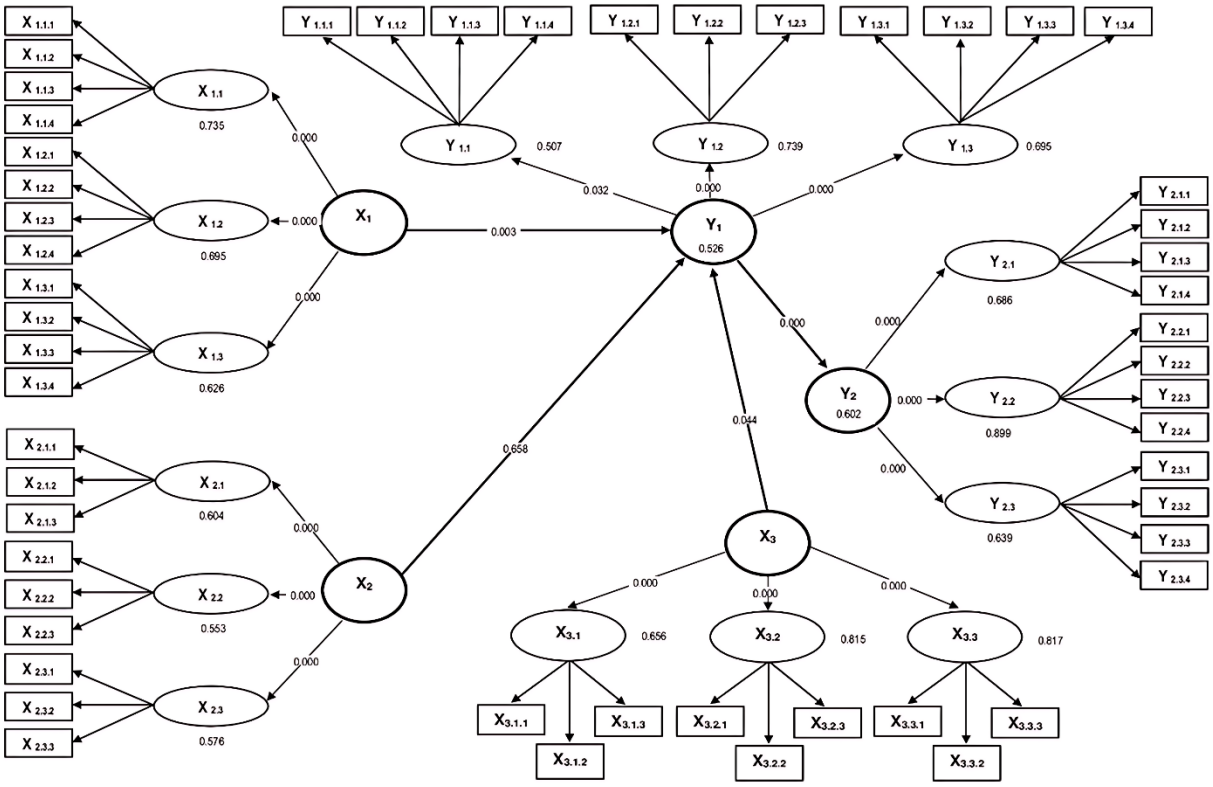

Figure 2.
Output Smart – PLS.

Based on the table above, the relationship between a variables can be explained as follows:

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Table 8.
Summary of Variable Results, P Values and Descriptions.

Variable	P values	Alpha 5%	Description
X1 -> Y1	0.003	0.05	Significantly affects Y1
X2 -> Y1	0.658	0.05	No significantly affects Y1
X3 -> Y1	0.044	0.05	Significantly affects Y1
Y1 -> Y2	0.000	0.05	Significantly affects Y2

Table 9.
Output Smart PLS.

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P Values
X1 -> X1.1.	0.857	0.860	0.034	25.341	0.000
X1 -> X1.2.	0.832	0.835	0.034	24.613	0.000
X1 -> X1.3.	0.725	0.733	0.055	13.266	0.000
X1 -> Y1	0.385	0.377	0.128	3.001	0.003
X2 -> X2.1.	0.777	0.777	0.065	11.918	0.000
X2 -> X2.2.	0.744	0.750	0.070	10.614	0.000
X2 -> X2.3.	0.759	0.768	0.053	14.274	0.000
X2 -> Y1	0.072	0.094	0.162	0.443	0.658
X3 -> X3.1.	0.810	0.813	0.041	19.988	0.000
X3 -> X3.2.	0.903	0.905	0.018	50.630	0.000
X3 -> X3.3.	0.904	0.906	0.018	51.148	0.000
X3 -> Y1	0.249	0.235	0.123	2.016	0.044
Y1 -> Y1.1.	0.327	0.376	0.152	2.146	0.032
Y1 -> Y1.2.	0.859	0.860	0.038	22.466	0.000
Y1 -> Y1.3.	0.834	0.827	0.056	14.810	0.000
Y1 -> Y2	0.634	0.636	0.072	8.814	0.000
Y2 -> Y2.1.	0.828	0.834	0.028	29.702	0.000
Y2 -> Y2.2.	0.948	0.948	0.009	108.206	0.000
Y2 -> Y2.3.	0.799	0.805	0.039	20.356	0.000

Table 9 and Figure 2 summarizes the significance values of each variable's impact on other variables. The significance value (P value) of variable X1 on Y1 is 0.003, which is smaller than the 5% alpha level (0.05), indicating that X1 has a significant effect on Y1. The significance value (P value) of variable X2 on Y1 is 0.658, which is greater than the 5% alpha level (0.05), suggesting that X2 does not have a significant effect on Y1. The significance value (P value) of variable X3 on Y1 is 0.044, which is smaller than the 5% alpha level (0.05), meaning X3 has a significant effect on Y1. The significance value (P value) of variable Y1 on Y2 is 0.000, which is smaller than the 5% alpha level (0.05), indicating that Y1 has a significant effect on Y2.

5. Discussion

The economic well-being of fishermen is crucial in determining the quality of life in coastal areas, particularly in regions like Pinrang Regency in South Sulawesi. This paper examines how three main factors—institutional empowerment, infrastructure development, and productivity—impact the livelihoods of fishermen in this area. Through the analysis of these factors, the paper seeks to highlight strategies that can enhance economic welfare and promote sustainable livelihoods for the fishing community.

5.1. Level of Fisherman Welfare in Pinrang Regency

The welfare level of fishermen in Pinrang Regency, particularly in the coastal area of Mattiro Sompe District, is assessed using indicators established by BPS. Provinsi Sulawesi Selatan [28]. Based on, the results of the analysis, the level of welfare of fishermen is in the "moderate" category with a total indicator score of 26.07, which includes aspects of income, household consumption, health,

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education, and security. Indicators that show high scores include household consumption, family health, ease of children's education, and religious life. However, fishermen's household income is still in the "sufficient" category and efforts are needed to increase income, most of which comes from fishing activities and side businesses. This study explains the importance of business diversification and providing training to fishermen to increase their income [29] the development of side businesses is very important to maintain the existence of local fisheries. The implications that can be used to improve the welfare of fishermen are the creation of policies that support income diversification, such as through entrepreneurship training and opening market access, so that it can improve the welfare of fishermen Recommendations for local governments where it is necessary to strengthen sustainable local-based economic empowerment programs.

5.2. Factors Strengthening Institutions, Empowering Fishermen, and Infrastructure Affecting the Productivity of Capture Fishermen in Pinrang Regency

The analysis results reveal that institutional strengthening, the empowerment of fishermen, and improvements in infrastructure play a crucial role in enhancing the productivity of fishermen in Pinrang Regency. The findings indicate that institutional strengthening, which encompasses fishermen's cooperatives and associations, has a significant impact on the productivity of fishermen [30]. The role of strong institutions can provide access to better training, technology, and markets. In addition, empowering fishermen through skills training can also contribute to increasing productivity, although no significant direct relationship was found between empowerment and productivity [31]. Meanwhile, improving infrastructure, such as port facilities and storing catches, has been shown to increase the operational efficiency of fishermen [32, 33]. With the conditions of Fishermen's Productivity in Capture Fisheries in Pinrang Regency, it is essential to strengthen local institutions and enhance the capacity of administrators to improve access to the resources required by fishermen. Strengthening financial institutions that support the fisheries sector should also be a priority. In addition, infrastructure improvements, such as the development of ports and storage facilities, will reduce fishermen's operational costs and increase their competitiveness [34].

5.3. Fishermen's Productivity Affects the Welfare of Capture Fishermen in Pinrang Regency

The productivity of fishermen in Pinrang Regency significantly impacts the welfare of the capture fisheries sector in the region. The findings of this study show that increased productivity is directly related to higher income for fishermen, which, in turn, enhances their access to basic necessities such as education, healthcare, and adequate housing [35]. Supportive infrastructure conditions and the use of more efficient fishing technology play an important role in encouraging fishermen's productivity. However, productivity variations are also affected by external factors such as weather conditions, market price changes, and government policies [36]. The results of the analysis and discussion, to improve the welfare of fishermen, increasing productivity must be a priority. Therefore, the government needs to support the provision of modern fishing gear, skills training, and sustainable management of natural resources. In addition, policies are needed that improve market access and price stability will also greatly support the welfare of fishermen [37, 38]. With these conditions, it is hoped that the welfare of fishermen in Pinrang Regency can increase, and their productivity can contribute to the sustainability of the local fisheries economy.

6. Conclusions

This research analyzes important factors that influence the economic welfare of fishermen in Pinrang Regency, South Sulawesi, with a focus on institutional empowerment, infrastructure development and productivity. The findings of the study indicate that institutional empowerment and infrastructure development play an important role in increasing fishermen's productivity, which in turn has a positive impact on fishermen's welfare. However, fishermen's empowerment, although important, did not show a significant effect on productivity in this study. From the results of the study, a holistic

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approach is needed that integrates factors to create sustainable improvements in fishermen's livelihoods. then Strengthening institutions, improving infrastructure, and encouraging better productivity through modern technology or techniques and resource management to achieve long-term welfare improvements. The recommendations for local governments are expected to improve institutional empowerment and performance, develop infrastructure such as fishing ports and cold storage warehouses, and promote sustainable fishing practices. These actions will help create a more resilient fishing community and achieve a stable and sustainable economy in Pinrang Regency. By focusing on this integrated solution, this area can improve the economic stability of the fisheries sector, ensure the long-term welfare of fishermen while maintaining the sustainability of productive marine resources.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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