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Analysis Of Harvest Productivity Improvementusing The Fmeamethodin The Vaname Shrimp Cultivation Industry

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Abstract

Background: Vannamei shrimp has a very potential market both domestically and abroad. PT XYZ, the Vannamei shrimp industry in Indonesia has not been maximized in its productivity. FMEAis a technique used to increase the reliability and safety of a process by identifying potential failures – or failure modes – in the process. This study aims to evaluate harvest productivity at PT XYZ, a company engaged in the vannamei shrimp farming industry based on the problems that exist in the operational sector.
Methods: Observing the problems that affect the productivity of vanamei shrimp harvest, especially in workers, methods, and technological innovations of the company. The analysis was carried out using the Fishbone diagram, why-why analysis, and FMEA methods to determine critical problems. The critical problems found were taken into consideration for brainstorming using the 5W+1H method to determine recommendations for improvement
Results: Human factors, methods, and technology have critical problems. Based on the calculation of the RPN in the FMEA method, it is known that the most critical problem is in the method factor, which is about the implementation of work not based on relevant data. The recommendation for improvement is that the company conducts an analysis related to the application of technology, making decisions about the application of technology significantly needed because the application of technology according to the company's needs can help overcome critical problems that occur.

Keywords: Vaname Shrimp Industry, Fishbone Diagram, Why-Why analysis, FMEA

INTRODUCTION

In this increasingly competitive industrial era, every company wants its production to produce quality products with effective and efficient production processes to continue to compete, as well as competition in the industrial world so that it can become a world-class company that can compete with companies from other countries.Full attention is paid to quality in manufacturing; however, less effort is made to develop the organizational performance, which drives overall manufacturing quality. PT. XYZ is a company engaged in the cultivation of vanamei shrimp. The type of product produced is vanamei shrimp, ready for consumption or reprocessed into other food products.

According to data from the Ministry of Fisheries from 2016 to 2020, shrimp is a potential export commodity. This is indicated by the increase in export volume from year to year. Vanamei shrimp cultivation in Indonesia is currently the mainstay of the aquaculture sector and a priority for aquaculture development in Indonesia to improve the

national economy. In the period 2012 - 2018, the contribution of the value of shrimp exports to the value of Indonesian fisheries exports reached an average of 36.27% (BPS, 2019). This means that shrimp commodities have a very significant role in the export performance of Indonesian fishery commodities. Even in 2020, shrimp is the commodity with the largest volume exported. This potential is a consideration that vannamei shrimp farming companies need to make improvements to achieve optimal productivity.

Table 1 Primary data of harvest productivity 5 harvest cycles

Variable	Cycle I	Cycle II	Cycle III	Cycle IV	Cycle V	TOTAL	NOMINAL
Harvest	11.576	8.000	10.500	10.115	12.300	52.491	3.411.915.000
FCR	1,52	1,25	1,42	1,4	1,68		
Feed	17.596	10.000	14.910	14.161	20.664	77.331	1.175.423.904

From the first harvest cycle until the 5th cycle at PT XYZ it was found that the harvest value and feed use were not linear, in the first cycle the feed value was much higher than the yield with a difference of almost 6000 Kg. In cycles II to IV, the difference in weight of feed and harvest was an average of 3485 kg, while in cycle V, another significant difference was found, namely 8364 kg. A significant gap was found between input and output in cycle 1 and cycle 5, while cycle 2 became a cycle that had the smallest gap value between input and output but produced the least amount of product. In addition, looking at other companies, FCR's ideal target is 1.1 – 1.2. The data above shows that the smallest FCR that can be achieved is 1.25, and even then with relatively small yields. The findings from the table data above raise the question of why the value of feed is not always proportional to the yield produced. The use of feed that is not effective on crop yields is one of the causes of suboptimal crop productivity. To be able to achieve the ideal shrimp weight as in the provisions of the partial and total harvest, monitoring incentives related to the development of shrimp weight is very necessary. Moreover, if the time coverage can be met or is expected to be faster, the accuracy of feeding is very important to pay attention to support the growth of shrimp weight. In the process of vaname shrimp cultivation, feed requirements are the largest operational needs that must be met. Feed requirements take up the largest portion of the cost of planning for the implementation of cultivation. This shows that the accuracy of feed management adapted to shrimp needs can affect profits (Pasaribu et al., 2017).

Based on the phenomena described previously, this research will analyze the problems that occur in the vannamei shrimp farming industry, especially in the production section.The cause of the problem has been found, the criticality is determined and the recommendation for repair is determined.

LITERATURE REVIEW

Harvest Productivity

Various concepts have been used by various companies to increase production operational productivity so that the production process becomes more efficient and results in sustainable company profitability performance. productivity is influenced by factors such as education, skills, discipline, mental attitude and work ethic, motivation, nutrition and health, income level, social security, work environment, and climate, highly humane working relations, technology, production facilities, management, and achievement opportunities.An increase or decrease in the value of productivity occurs due to a change in the output produced or a change in the input used, meaning that if there

is a change in the input, the productivity value will change(Zuhdi et al., 2019).

Fishbone Diagram

A Fishbone diagram which is often referred to as a Cause and Effect diagram is a diagram that resembles a fishbone that can show the cause and effect of a problem. Fishbone Diagram helps uncover the symptoms of a business problem by evaluating the causes and sub-causes of a problem(Sakti et al., 2020). The relationship between the effects and causes of problems on the fishbone is depicted in a picture. The main problem will be made on the main bone and the causes of the problem are described in the fishbone sub-sub, there are 3 scopes of the causes of the problem in this study, namely workers, methods, and technology. Problems found are processed with fishbone diagrams, to know the causes of these problems.

5 Why Analysis

The 5 Whys analysis is a structured approach in which asking “why” questions repeatedlyto understand the cause of the problem(Kuswardana, 2017). The 5 why analysis method was first developed by Sakichi Toyoda and used as a methodology for Toyota Motor Corporation during their manufacturing development. This method is an important part of the problem-solving process that is part of the Toyota Production System. Root Cause method Analysis "5 why analysis" by asking why 5 times orrepeatedly to find the root of a problem.

Fmea

FMEA is carried out to see the possibility of crop failure which is influenced by predetermined factorswhich are then used to get recommendations for possible improvements. Each failure mode will be assessed using three parameters, namely:

1. Severity (severity - S)

Table 2. Scale ofSeverity

Impact	Criteria	Rating
Danger, Failure occurs without warning	Not in accordance with the SOP, out of control, total production failure.	10
Seriously, Failure occurs with a warning	Not in accordance with SOP, out of control, partial production failure.	9
Extreme	Disrupt the smooth running of the production system - The product is very unsatisfactory.	8
Major	Slightly interfere with the smooth production process - The product is not perfect but can still be used and accepted.	7
Significant	Product performance has decreased because certain functions may not operate properly.	6
Currently	Product performance has decreased but can still be improved.	5
Low	Product performance has decreased but does not require improvement.	4

Small	Minor impact on production systems or product performance – there is still product scrap.	3
Very Small	Very little impact on production systems or product performance – there is still some scrap but very little.	2
No Impact	No impact on production systems or products.	1

2. Chance of occurrence (occurrence - O)
   Occurrence is the frequency with which damage or failure occurs. The occurrence rating value is between 1 to 10. A value of 10 is given if the failure that occurs has a high cumulative or occurs very often.

Table 3. Scale ofOccurrence

Chance of Failure	Possibility	Rating
Very high and extreme; failure is almost inevitable	1 of 2	10
Very high; failure is related to a previously failed process	1 of 3	9
High: failure related to a procedural error	1 of 8	8
Relatively high	1 of 20	7
The medium tends to high	1 of 80	6
Currently	1 of 400	5
Relatively Low	1 of 2000	4
Low	1 of 15000	3
Very Low	1 of 100000	2
Almost impossible to fail	1 of 1000000	1

3. Possible detection failure (detectability - D)
   Detection is a measurement of the ability to control or control failures that can occur by considering the possibility of detecting failure modes or causes under established criteria.

Table 4. Scale ofDetectability

Detection	Criteria	Rating
Almost impossible	No controls to detect potential failure	10
Very Small	There are very few controls to detect potential failures	9

Small	There are few controls to detect potential failures	8
Very Low	There is control but very low ability to detect potential failures	7
Low	There is control but low ability to detect potential failures	6
Currently	Some controls have moderate/sufficient capability to detect potential failures	5
Quite High	There is a control that has a moderate ability that tends to be high to detect potential failures	4
High	Some controls have a high ability to detect potential failures	3
Very High	Some controls have a very high ability to detect potential failures	2
Almost sure	Controls can almost certainly detect potential failures	1

The three parameters were then combined to determine the criticality significance of each failure mode. The combination of these three parameters is known as the Risk Priority Number (RPN)(Alijoyo et al., 2020).The analysis step with FMEA begins by identifying the problem based on the factors of worker productivity and harvest productivity that have been determined. Determination of the problem is done by conducting observations and interviews with related parties in the company.

Improvement Proposal 5W+1H

The stage after knowing the relationship between the causes and effects of the problem until finding a solution by describing the best decision about the application of the right action is to find the right improvement proposal to overcome the cause of the effect. The 5W+1H process is carried out by asking What, Where, When, Why, Who, and How based on the findings of the problem so that it can determine recommendations for improvement(Suherman & Cahyana, 2019). This is done by conducting interviews with related parties and making direct observations of the production site.

RESEARCH METHODS

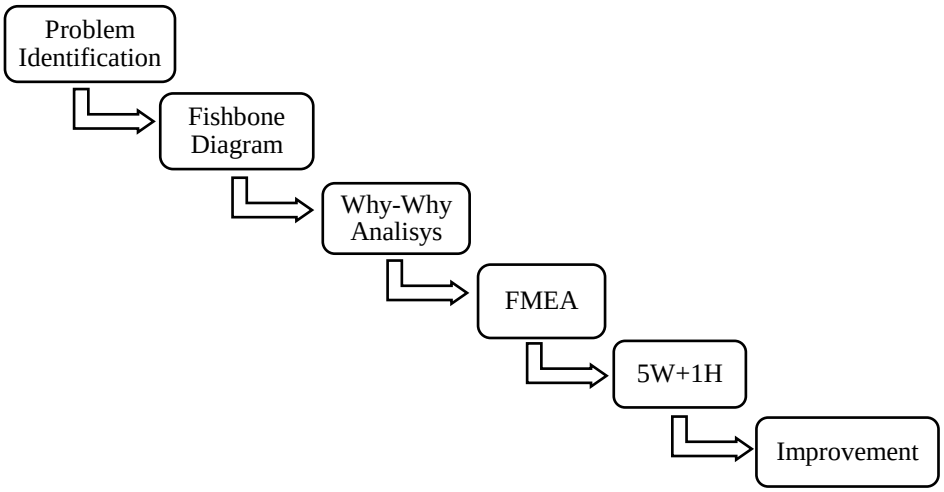

Figure 1. Process Analysis

This study aims to find critical problems that affect crop productivity. The problems found are then analyzed to get recommendations for improvement to make harvest productivity more effective. In more detail, the research steps were carried out as follows:

1. Problem identification is carried out by observing and conducting interviews with workers in the production and management divisions.
2. Data in the form of problem identification is displayed in the form of a fishbone diagram to get to the root of the problem.
3. In more detail, root cause analysis is carried out using the 5 Why analysis method.
4. Problems that have been identified are carried out by a further analysis process to find critical problems using the FMEA method. Failure Mode and Effects Analysis (FMEA) is the stage of identifying the severity of product defects (severity), the incidence of product defects (occurrence), and the level of product defect detection (detection), then calculating the Risk Priority Number (RPN) by multiplying the severity value, the value occurrence, and detection value. After calculating the value of the risk priority number (RPN), the RPN value will be obtained from the multiplication of the severity, incidence, and detection values for each failure mode obtained. Then sort the largest RPN value to the smallest to take corrective steps according to the largest RPN value.
5. Critical problems obtained based on FMEA analysis are taken into consideration to determine recommendations for improvement using the 5W+1H method.
6. The final result is in the form of suggestions for improvement that will be given to the company.

All of the factors studied are internal because performance items involving internal companies will be easier to fix(Widjajanto & Rimawan, 2021).While the data collection is done by using the method of interviews, discussions, and observations with the sample population is the entire workforce at PT. XYZ which has a task in the division of 42 people, the determination of the sample using the

saturated sampling method, then all members of the population are used as respondents.

RESULT

Problem Identification

The data obtained from the company is data from observations, discussions, and interviews. Researchers conducted observations, discussions, and interviews to find out the problems that affect crop productivity based on the use of feed that often occurs in the company. From the results of observations, discussions, and interviews, the researchers obtained several problem items that occurred in the company, which were categorized into several categories of problems:

Table 1. Problem analysis

Factor	Reason
People (competence & Motivation	Lack of worker discipline
	Workers do not understand the SOP in operating the machine
	Workers do not follow the SOP
	Unskilled operator.
Method	SOPs are not updated regularly
	Production problem analysis is only based on experience and estimates
Technology	The application of monitoring technology is minimal
	Workers have difficulty using tools.
	Tool damage

Based on the problem data in table 1, it is shown that there are 3 categories of problems, namely the human category, method, and technology. In the human category, there are 2 factors, namely the competence factor and the motivation factor. The problems shown are the problems at PT XYZ that affect the wastage of feed use. Waste of feed is considered a serious problem that causes ineffective crop productivity. This is because feed is part of the operation that requires the greatest financing. Moreover, the use of feed with improper calculations results in poor water quality, so it is very risky for crop production.

Fishbone Diagram

Fishbone diagrams are used to show problems and the root causes of problems that occur in the company. Fishbone diagrams are made to identify the factors that cause low productivity of vanamei shrimp culture products with human factors (motivation and competence), methods, and technology. Figure 2 is a fishbone diagram in the case of productivity in the production division of the vanamei shrimp industry.

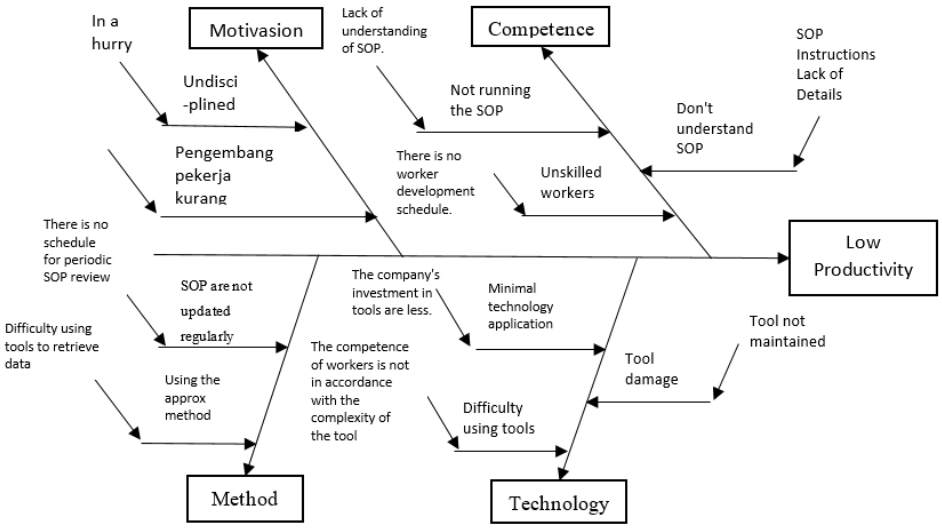

Figure 2 SEM-PLS Analysis Flowchart

Based on Figure 2, the problem to be analyzed is low productivity. The following is an analysis of each of the factors causing low productivity:

1. Motivation

The motivational factor is shown that the problem of lack of discipline in workers is caused by hasty factors. The second problem is that the development of workers is not scheduled because there is no worker development schedule.

2. Competence

The competence factor is shown that the problem of workers not carrying out SOPs is because workers do not understand SOPs. The second problem is not understanding the SOP because the SOP is not clear. The third problem is that unskilled worker are caused by the absence of a worker development schedule.

3. Method

The method factor shows that the SOP problem is not updated regularly because there is no periodic review schedule. The second problem is that workers do not use data according to conditions because workers have difficulty using tools to retrieve data.

4. Technology

Technological factors are shown that the application of technology is still minimal due to the lack of company investment in tools. The second problem is that workers have difficulty using technological tools because the competence of workers does not match the complexity of the tools. The third problem, namely tool damage caused by no tool maintenance activities.

5 Why Analysis

To perform a more detailed root cause analysis, a problem analysis was carried out using the 5 Why analysis method. By using the 5 Why analysis method, it is hoped that the main root cause of the problem can be found. The following is a table of 5 why analysis results:

Table 2. Analysis 5 Why

Factor	Problem	Why	Why	Why	Why	Why
Motivation	Undisciplined	In a hurry	There is a desire to do other work.	Feeling work has a lot of time gaps.	Understanding of the job desk and SOP is still lacking.	Briefing and monitoring by management are still lacking
	Unscheduled employee development	There is no worker development schedule	There is no worker training that needs analysis.	Lack of worker supervision.	There is no supervision or monitoring schedule from management.	Limited supervisory staff.
Competence	Not running SOP	Lack of understanding of SOP.	SOP Instructions Lack of Details	The use of tools is required in implementing the SOP.	Several conditions in the fluctuating field need consideration.	Influenced by the natural conditions of the field.
	Unskilled workers	There is no worker development schedule.	There is no worker training that needs analysis.	Lack of worker supervision.ngnya supervisi pekerja.	There is no supervision or monitoring schedule from management.	Limited supervisory staff.
	Don't understand SOP	SOP Instructions Lack of Details	The use of tools is required in implementing the SOP	Several conditions in the fluctuating field need consideration.	Influenced by natural conditions.	Water conditions are the main parameter.
Method	SOP is not updated regularly	There is no schedule for periodic SOP reviews.	SOP is considered still relevant by the management.	Understanding of SOP by management and workers is out of sync.	Lack of training and socialization related to SOP.	Field supervision by management is still lacking.

	Using the approx method	Difficulty using tools to retrieve data.	Competence of workers who do not match the complexity of the tool.	The tool is too difficult to implement.	The application of technology is not complete.	The company is still looking at the effectiveness of implementing the technology.
Technology	Minimal technology application	The company's investment in tools is less.	Available tools are not used.	Difficulty using tools.	The competence of workers is not in accordance with the complexity of the tool.	Lack of training provided by the company.
	Difficulty using tools	The competence of workers is not in accordance with the complexity of the tool.	The use of tools requires special understanding to make decisions.	The application of technology is not complete.	The company is still looking at the effectiveness of implementing the technology.	Infrastructure development and training require large funds.
	Tool damage	Tool not maintained.	There is no maintenance schedule.	There are no technicians as nursing officers.	The company's consideration for the application of the tool is still small.	Existing tools are still rarely used.

Based on the results of the 5 why analysis, for each problem the question "why" is asked 5 times so that the answer to the 5th "why" question is the root of the problem. The next table 2 will be used as a consideration to determine recommendations for improvement combined with the results of the FMEA analysis.

FMEA Analysis

After getting the problem formulation, an assessment instrument was made to calculate

the SOD and RPN values. The results of the calculation of the RPN value are as follows:

Table 3.RPN Value Calculation Results

Factor	Problem	Impact	Severity	Occurrence	Detection	RPN
Motivation	Lack of worker discipline	Company target not achieved	5,1	5,9	3,6	109,5
	Unscheduled employee development	Decrease in the quality of workers	5,4	5,2	4,7	130,1
Competence	Workers do not follow the SOP	Operations are not optimal	5,0	5,6	4,4	122,5
	Workers do not understand the SOP	Employee performance is not optimal	4,8	4,9	3,6	85,0
	Unskilled operator	Employee performance decreases	5,3	5,0	3,7	98,1
Method	SOPs are not updated regularly	Operations are running ineffective	5,2	5,1	4,0	106,5
	Production problem analysis is only based on experience and estimates	Company experiencing maladministration	5,3	6,2	5,0	163,1
	The application of monitoring technology is minimal	Ineffective work progress	4,9	5,9	3,7	106,8
Technology	Workers have difficulty using tools.	Working hours are not used effectively	4,8	5,8	5,3	148,1

	Tool damage	Target achievement is not realized	4,6	5,3	3,5	87,1

Based on the results of the RPN calculation, the results are shown in Table 2. It is shown that the RPN value varies, where the largest RPN value is the most critical problem. To determine recommendations for critical problems, 4 critical problems are discussed to determine recommendations for improvement using the 5W+1H method.

Recommendations of Improvement Using the 5W+1H Method

Critical problems that have been identified using the FMEA method are discussed using the 5W+1H method. The analysis of improvement recommendations for the 4 critical problems is shown in table 4.

Table 4.5W+1H Results

No.	Faktor	What	Why	Where	When	Who	How
1	Work execution is not based on data.	Application of expert systems for work execution decision making.	To make it easier and not add to the operator's workload.	Production operational support tools	Performed during the production pause, before the next production cycle is carried out.	Company management.	Create an expert system to provide information related to special conditions that must be treated according to field data.
2	Difficulty in using tools (Implementation of technology).	Implementation of training relevant to technology implementation.	So that employees can use and apply the technology provided by the company in accordance with company goals.	Production Operations Division.	Done when there is the development of tools or in special conditions where training for employees is needed.	Production operations employees who are concerned with and use the tools.	Analyze the results of supervision, conclude the conditions/needs for training, and carry out training as needed.

3	Unscheduled employee development.	Carry out periodic supervision of workers, scheduling development based on the results of supervision.	For the competence of workers to develop in accordance with the needs of the company.	Cultivation industry production operational division.	Scheduled and implemented consistently.	Management HR	Making a schedule for supervision and training by management to be carried out consistently
4	Employees don't follow SOP.	Implementation of the work implementation validation system according to the SOP manually and system	So that the SOP is guaranteed to be implemented by employees	Cultivation operations division	Done when carrying out production operations	Feed management operators and pond monitoring officers.	The system is implemented by filling out the instrument used every time you go to and finish the work procedure.

DISCUSSION

Problem Analysis Results

Based on the FMEA analysis carried out, it was found that there was a critical problem from the 4 factors studied. The problem with the method factor, namely regarding workers who work without relevant field data, is the problem with the highest RPN value. The second critical problem is from the technological factor, namely the difficulty of workers in using technological tools. The third critical problem is from the motivation factor, namely the development of unscheduled workers. The fourth critical problem is the competence factor related to workers not implementing SOPs.

By looking at the results of the 5 Why analysis, it is found that the roots of critical problems are as follows:

Table 5. The root of Critical Probleme

Problem	Reason
Work execution is not based on data.	The company is still looking at the effectiveness of implementing the technology.
Work execution is not based on data.	Infrastructure development and training require large funds.
Unscheduled employee development.	Limited supervisory staff.

Employees don't follow SOP.	Technical work is influenced by the natural conditions of the field.

Recommendations of Improvement

By looking at the critical root problem data found, it can be seen recommendations for improvement based on the results of the 5W+1H analysis as follows:

Table 6. The root of the problem and improvement

Problem	**Improvement**
Work execution is not based on data.	Application of expert systems for work execution decision making.
Work execution is not based on data.	Implementation of training relevant to technology implementation.
Unscheduled employee development.	Carry out periodic supervision of workers, scheduling development based on the results of supervision
Employees don't follow SOP.	Implementation of the work implementation validation system according to the SOP manually and system

CONCLUSION

Based on the data from the analysis that has been displayed, it can be concluded as follows:

1. Human factors, methods, and technology have critical issues that affect productivity.
2. The application of technology needs to be carried out in full in accordance with the needs of the company, the implementation of technology can greatly help overcome various technical and methodical problems with the consequences of implementing technology followed by competence in using technology by workers.
3. The application of technology can solve the company's critical problems, but its implementation requires investment in both infrastructure and skilled workers.

SUGGESTION

The company needs to conduct further analysis regarding the application of technology to support the productivity of the vannamei shrimp industry. The analysis is intended to assist companies in making decisions to dare to invest or not to able to apply technology. The method that has been done many times is related to the application of technology in the white shrimp cultivation process, often referred to as the "Millennial Shrimp Farming" method can be used as an illustration of the total application of technology to increase crop productivity.

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