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Lean management in aquaculture: A practical guide for smallholder fish farmers



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Lean management in aquaculture: A practical guide for smallholder fish farmers

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Introduction

Welcome to this guide on lean management for fish farmers. Are you tired of high costs and inefficiencies that are stealing your profits? Do you feel overwhelmed by complex approaches to solving these issues? If so, you're in the right place. This guide is designed to provide a simple, step-by-step solution to help you address these major thieves in fish production quickly and effectively.

Meet Mary, a small-scale fish farmer just like you. She is frustrated with the high costs of feed and fuel and is overloaded with farm tasks. But with lean management, Mary is hoping to transform her farm from barely sustainable to profitable and thriving. And with the roadmap provided in this guide, you can do the same.

Are you tired of running a farm that's just barely scraping by? Well, lean management is the game-changer you've been looking for. This system is chock-full of powerful tools, methods and structures that can make your farm more efficient and profitable. By implementing the principles in this guide, you can improve your operations by a staggering 80 percent or more. And that's not all—the overall increase in revenue could soar past 33 percent. So why wait? Take your farm to the next level with lean management today.

Throughout this guide, we'll take you on a journey with Mary, a fictional character representing a typical small-scale catfish farmer, as she implements lean management on her farm. You'll learn about the fundamental principles and tools of lean management and how to apply them to your own operation. By the end of this guide, you'll have the knowledge and skills you need to transform your small-scale fish farm into a lean, mean, profit-making machine.



1. Jump into lean

Are you tired of inefficient processes, wasteful practices and low profitability in your aquaculture business? Look no further than lean management! This approach has revolutionized industries worldwide, and aquaculture is just getting started. So let's begin a new era of aquaculture management.

Lean management, also known simply as "lean," is all about minimizing waste and maximizing value for the customer, which translates into lower costs, improved product quality and higher profits for the producer. By examining your processes critically and implementing creative, low-cost solutions, you can maximize your production efficiency with minimal waste. And the best part? Implementing lean principles comes with little to no cost.

The core principles of lean management involve minimizing waste, maximizing value and continuously improving processes. In aquaculture, this can mean using less water, minimizing feed waste, improving fish quality and optimizing energy consumption. By fostering a culture of bottom-up problem-solving, lean management also creates a positive work environment that is respectful, engaged, accountable and collaborative.

In light of this, focusing on the skillsets and growth potential of your farm's personnel is highly recommended. To achieve this, one practical approach is to fill out an employee skills reference form.

Take a moment to think about the people around you and your farm. Then fill out the form in Figure 1 to have a good reference sheet for you to quickly identify and tap into the skills and temperaments that can help you address farm issues as they arise.



Employee Skills Reference Form



Name	Job Title	Skills	Growth Opportunities	Personality Traits	Other Information

Figure 1. Employee skills reference form.

Employee Skills Reference Form Example

Name	Job Title	Skills	Growth Opportunities	Personality Traits	Other Information
John	Farm Manager	Fish husbandry, water quality management, feed formulation, record-keeping	Leadership training, project management, business development	Organized, analytical, responsible	Has 5 years of experience in fish farming, previously managed a small farm
Grace	Fish Health Specialist	Fish disease diagnosis and treatment, water quality management, data analysis	Veterinary training, aquaculture research, team management	Detail-oriented, independent, proactive	Holds a Bachelor's degree in Fisheries and Aquaculture, recently completed an internship at a research institution
Michael	Farm Technician	Fish feeding, pond maintenance, equipment operation, record-keeping	On-the-job training, machinery repair and maintenance	Physically fit, adaptable, team player	Has 2 years of experience in fish farming, previously worked on a poultry farm

Figure 2. Example of a completed employee skills reference form.

Knowing your employees is an important part of lean management, as it taps into skillsets and personality traits on your farm to drive changes through a bottom-up problem-solving and teamwork culture. For this, an employee skills reference form can be used to quickly reference an employee's abilities, potential for advancement, personality traits and other pertinent details. This information can help you identify an employee's strengths and weaknesses, assign tasks and responsibilities, provide training and development opportunities, and make informed decisions about promotions or hiring. It can also help you identify gaps in skills or experience that you need to fill through either recruitment or training.

One of the most significant advantages of lean management is that it empowers employees and involves them in the improvement process. By providing training and resources and encouraging employees to identify and suggest improvements, farmers can build a culture of continuous improvement and increase employee engagement, motivation and satisfaction.

Implementing lean management principles requires a strong desire to take action and move

away from business as usual. Small-scale fish farmers must be willing to critically examine their processes and identify areas for improvement. By doing so, they can increase their competitiveness and achieve long-term success in the industry.

Mary is a prime example of a farmer who is ready to step up and do the work it takes to elevate her farm to the next level. Mary sees how implementing lean management principles can lead to significant improvements. By reducing waste and improving efficiency, Mary expects to improve the quality of her fish and increase her profits.

Lean management is a powerful approach that can significantly benefit the aquaculture industry. By minimizing waste and maximizing value, businesses can improve the quality of their products and increase their profits while reducing their environmental impact. In addition, by learning the principles of lean management and applying them to their operations, small-scale fish farmers, like both you and Mary, can make significant improvements at zero cost to them. So why wait? Jump into lean management and experience a new era of aquaculture management.

2. Setting your sights

Are you ready to get organized and take your aquaculture business to the next level? In this chapter, we will help you identify your top priorities and turn them into actionable goals. But we won't stop there. We'll also introduce you to Mary's farm, where Mary is struggling with low profits because of the high costs of feed and fuel. Finally, we'll show you how Mary turns her concerns into goals and prioritizes them to achieve success.

First, let's get clear on your top priorities.

2.1. Prioritizing and goal setting

A great way to start this activity is to ask yourself a critical question about your farm operations.

What are the biggest problems on your farm?

Typical answers include not enough money, dying fish, too much work to do, high cost of feed, running out of fuel, inventory theft, water quality, etc.

Let's take a moment to dive deep into this crucial question, because identifying and prioritizing your primary concerns is critical to achieving success. Once you've identified your top three to five problems, it's time to turn them into prioritized goals. This step is crucial to ensure that you focus on the issues that matter most to set yourself up for success. So, let's get started!

Now, take a moment and think deeply about this critical question.

1. First, write down the main problems on your farm that come immediately to mind.
2. Next, look at them and determine the ones that would make the most significant impact if they were solved; it is essential to identify and prioritize your main concerns.
3. Finally, turn your top three to five problems into goals to address.

Follow these three steps and write your top goals in the form in Figure 3.



Goals - Exercise

List 3 - 5 goals



1.

2.

3.

4.

5.

Figure 3. Goals exercise.

We will also do this goal-setting activity for Mary's farm. But first, let's look at Figure 4 to get a little more familiar with the farm itself.

2.2. Description of Mary's farm

Mary has a one-hectare farm with two catfish ponds, each with its own water pump. She also has a handy storage shed on-site that keeps all the supplies and feed she needs for her fish.

Mary is always busy managing her farm. She does everything from preparing her ponds to managing the water supply and keeping a watchful eye on inventory control. Of course, there are the issues of harvesting and transportation as well as finding the perfect buyers for her fish. Mary has one employee on-site to help her feed the fish and make sure the ponds have a good water flow to keep everything clean and healthy.

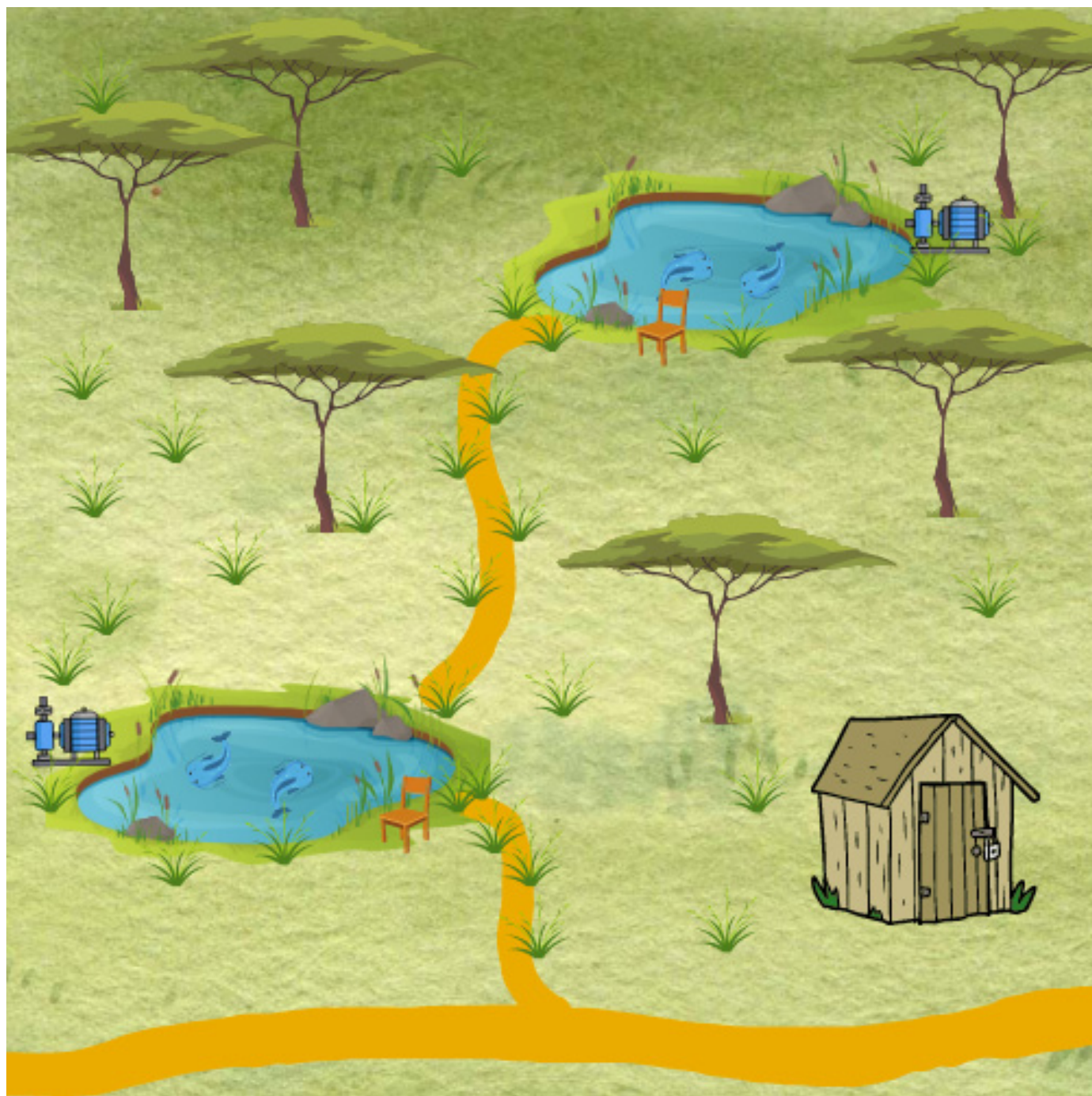


Figure 4. Mary's farm.

What's the biggest concern that keeps Mary up at night? She wants to know how to improve her low profits. With her experience, she knows the high costs of feed and fuel on her farm take a bite out of her profits. Being responsible for most of the farm's activities, Mary feels exhausted from being overworked.

In one of her first steps into lean management, she takes these issues, converts them into goals, and records them as her top priorities, as shown in Figure 5.

As a small-scale fish farmer like Mary, determining your top goals is crucial because it helps you identify and prioritize the most critical issues that you need to address in your operation. By focusing on the problems that matter most, you can set yourself up for success and make meaningful improvements that can lead to higher profits, improved efficiency and overall success in your aquaculture business. By converting your identified problems into prioritized goals, you can create a roadmap that guides your decision-making, making it easier to track progress, measure success and ultimately achieve your desired outcomes.



Figure 5. Mary's goals for her farm.

3. The power of mapping

Welcome to chapter 3, where we dive into one of the most powerful lean management tools available: value stream mapping. Now that you have identified your top goals, it's time to focus on how to achieve them efficiently and effectively. This chapter will explore how to use the value stream mapping tool to streamline your processes and maximize your output. By mapping out the steps needed to achieve a specific goal and pinpointing areas of waste and inefficiency, you'll be well on your way to improving your operations and reducing costs. So, get ready to take your farm to the next level as we guide you through the practical application of value stream mapping.

3.1. Value stream mapping: Definition and practical application

First, it's important to understand how lean management defines value. Value is any action or process that directly contributes to meeting the needs of the customer. Now, let's apply this thinking specifically to small-scale fish farmers. A fish farmer's value is providing their customers with a high-quality, nutritious and sustainable source of protein.

Value stream mapping is a lean management tool that helps document that value. A value stream map (VSM) clearly outlines the steps in the process and highlights opportunities for improvement to streamline your operations quickly. In addition, each step of the process shows related metrics like time, materials and resources, so you'll be able to pinpoint areas where you can cut waste and boost efficiency. With the value stream mapping tool in your arsenal, you'll be well on your way to optimizing your aquaculture processes and maximizing your output. So, get ready to take your operations to the next level!

To create a VSM, carry out the following steps:

1. Start by determining a specific process to focus on that will help you achieve your goals.
2. Write down the significant steps needed to achieve each goal in the order it is accomplished; there should be about 10 steps, but no fewer than five and no more than 15.
3. After you map the steps, make notes of critical measurements for each one, such as the amount of time to complete that step, the equipment needed, the amount of materials used and the number of people it takes to carry it out.

Once the VSM is complete, you have a fantastic one-page communication tool for evaluating and improving your targeted process.

Begin practicing this tool by following the three steps above to map one of your farm's processes using the template in Figure 6.

Value Stream Mapping Exercise

List the process steps in order



	—		—	
	—		—	
	—		—	

Figure 6. Value stream mapping exercise.

Excited to make a big impact on her farm, Mary hones in on her goal of reducing her feed costs and gets to work using the value stream mapping tool. She maps out the various steps involved in feeding her fish and notes how they are typically carried out.

Well done! You now know about the potent lean management technique called value stream mapping and how it can help you optimize the

processes on your farm to achieve your goals. By following the steps outlined in this chapter, you can start mapping out your processes, pinpointing areas of waste, and increase efficiency to maximize your output. Remember, value stream mapping is not a one-time task but an ongoing process that can help you continuously improve your operations, so we will continue to use it as we progress throughout this guide. Don't hesitate to implement this tool and start impacting your farm today.

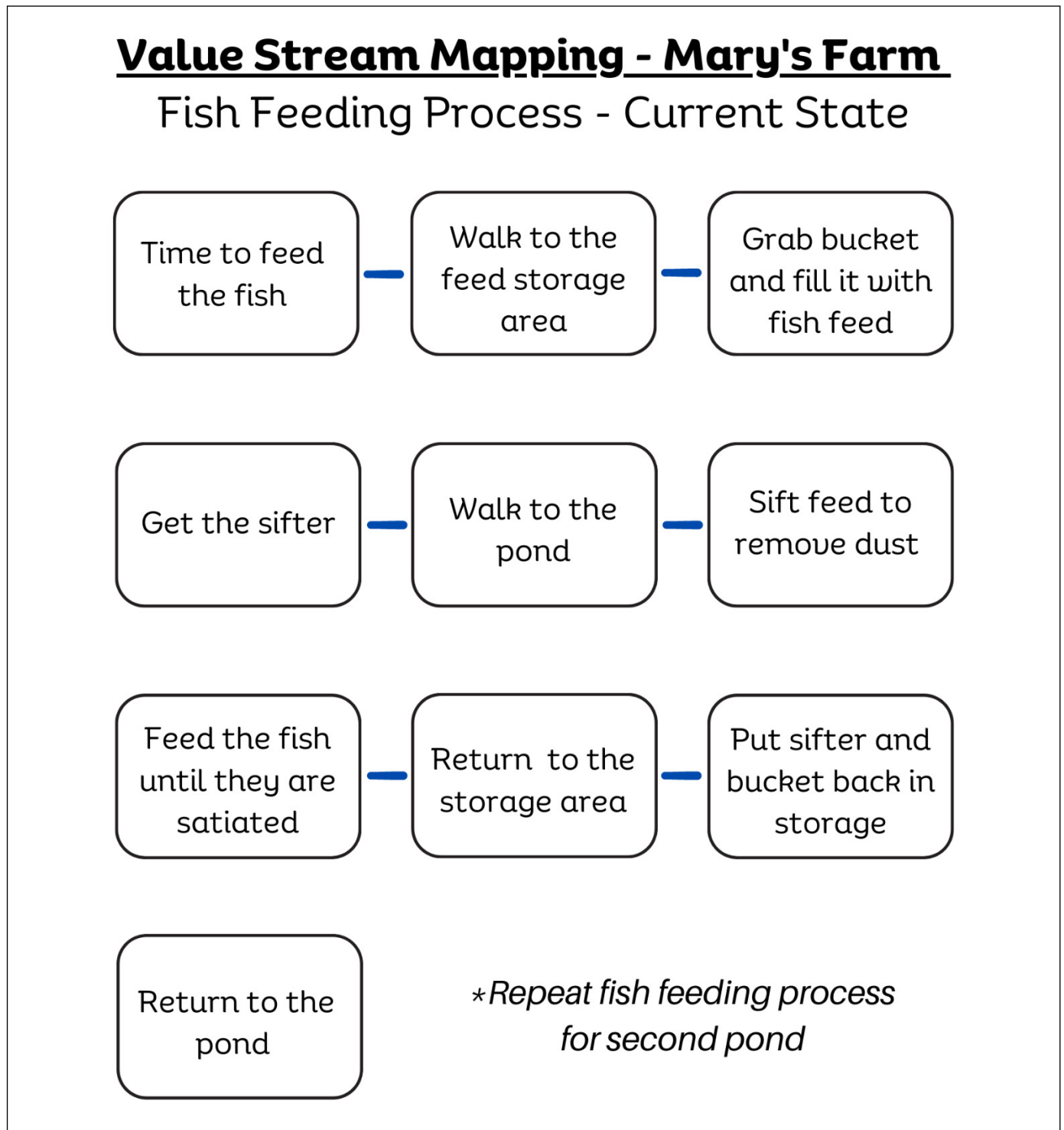


Figure 7. A VSM for Mary's farm.

4. Untangle inefficiencies

4.1. The spaghetti diagram tool

Welcome to the spaghetti diagram tool, a powerful visual representation of your farm's physical layout that can help you identify inefficiencies and improve your operations. With this tool, you can capture motion, equipment and materials to pinpoint areas of congestion, unnecessary movement or inefficient layout. By following the steps outlined in this chapter, you can create your own spaghetti diagram and use it to optimize your farm's layout. The resulting visual tool will quickly reveal inefficiencies in your process and provide opportunities for improvement. So, let's get started by learning how to create a spaghetti diagram and why it's such an effective tool for lean management in aquaculture.

To create a spaghetti diagram, carry out the following four steps:


1. Start by drawing a rough sketch of your farm's layout from a bird's-eye or top-down view.
2. Next, draw the location of essential parts of your farm, such as ponds, water sources, processing facilities, harvesting areas, administrative buildings, major equipment and storage areas.
3. Next, draw a line on the layout sketch to indicate the movement that the person doing the work takes.
4. Use different colors to create more complex diagrams that can separate and track the movements of materials, equipment and additional people.

Your resulting spaghetti diagram will reveal a visual tool that quickly identifies inefficiencies. It will show many drawn lines, illuminating excessive movement in both distance traveled and repetitive motion in your process.

Use the form in Figure 8 to practice using this tool by sketching the layout of your farm; it's just a rough sketch, so it does not need to be perfect.

Spaghetti Diagram Template

Rough sketch of your farm layout



Note: Use different colors to track movement of people, materials and equipment, like the previous example, Mary used a pink pencil to track her process.




Figure 8. Spaghetti diagram template.

Let's see how Mary begins using this tool by sketching her farm's layout; it's simply a representation, so it doesn't have to look perfect.

The spaghetti diagram tool is a valuable visual representation of your farm's layout that can help you identify inefficiencies and improve your operations. By following the steps outlined in this chapter, you can create your own spaghetti diagram and start pinpointing areas of waste and

inefficiency in your farm processes. Remember, this tool is not a one-time task but an ongoing process that can help you continuously improve your operations, so we will continue using it as we progress throughout the guide. By implementing the spaghetti diagram tool and other lean management principles, you can increase your profitability, improve your product quality and minimize your impact on the environment. So, take action to make your aquaculture business thrive!

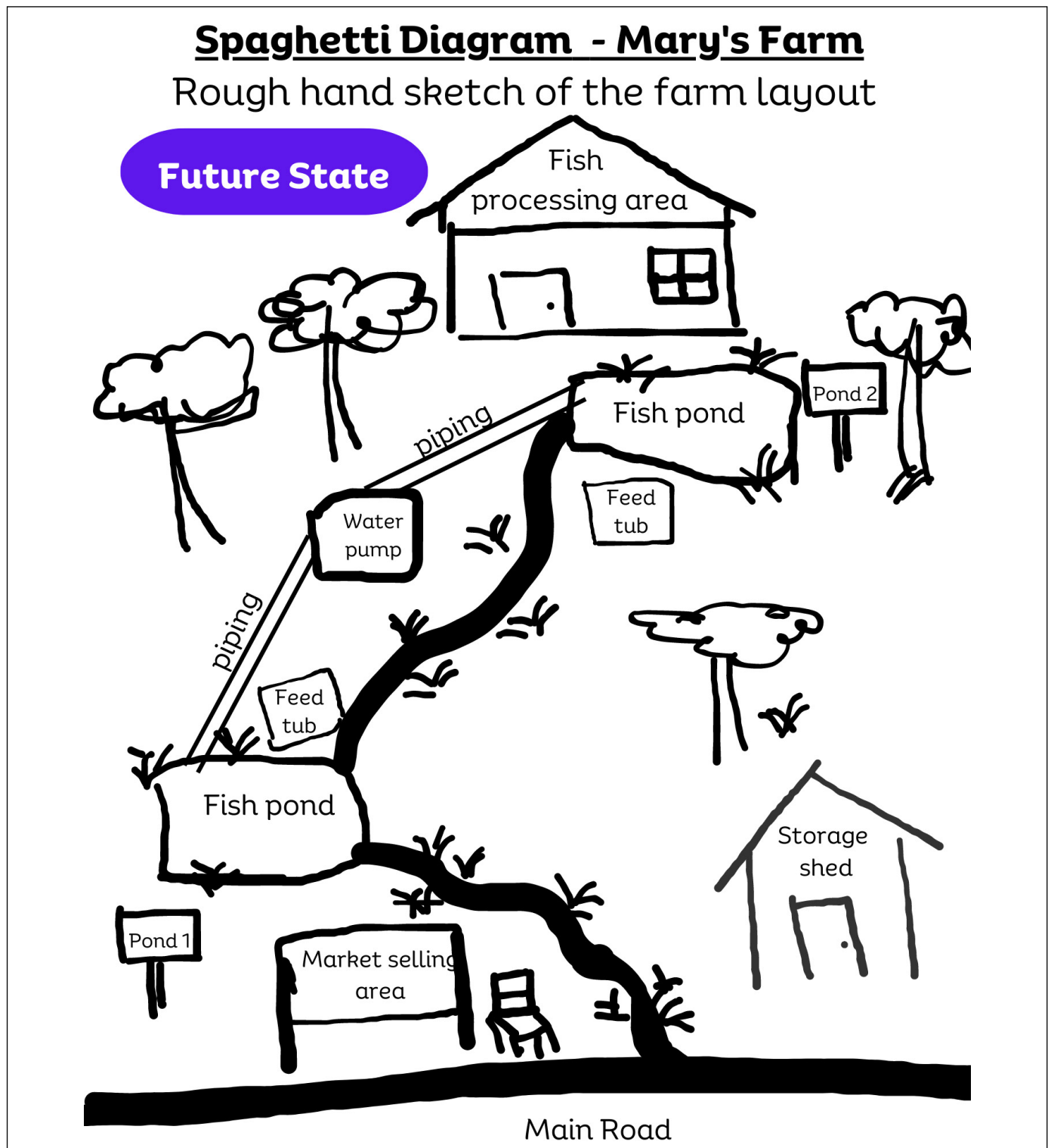


Figure 9. A spaghetti diagram of Mary's farm.

5. Grow awareness

If you are like Mary, you want to get the most bang for your buck. The way to do this is by maximizing the value you create while minimizing any waste holding you back. Lean management focuses heavily on these two primary principles: creating value and eliminating waste.

5.1. Value

As mentioned in Chapter 3, value is defined as any activity or process that directly contributes to delivering a product or service that meets the needs and requirements of your customers. Understanding what your customers truly value is critical to delivering it consistently. As such, value is determined by your customers and is always associated with a specific product or service. As a fish farmer, it is essential to understand what your customers truly value.

Generally, customers want fish that meet the following six criteria:

1. **Freshness:** Customers want fish that are freshly harvested and have not been stored for a long time.
2. **Quality:** Customers want fish that are healthy and free from diseases or parasites, with firm flesh and a pleasant smell and taste.
3. **Size and weight:** Customers may prefer buying fish of a certain size and weight, depending on their needs and how they intend to use the fish.

4. **Cleanliness:** Customers want fish that have been properly cleaned and gutted, with no scales or debris left on the fish.
5. **Price:** Customers want to buy fish at a fair price, which can vary depending on the conditions at local markets.
6. **Convenience:** Customers may prefer to buy fish in easy-to-use portions or fillets, or packaged in a way that makes them easy to transport and store.

When it comes to purchasing fish, customers typically look for freshness, high quality and affordability while also having preferences for size, cleanliness and convenience. In addition, the customer's interest could differ depending on location, customs and the socioeconomic structure. Because of these factors, you should familiarize yourself with the interests of your target customers in order to avoid waste. Fish farmers must understand the specific value their customers want and seek to deliver it consistently.

Identify and prioritize any unique customer demands that you have discovered, especially those that you need to give more attention to. Then, document them in the form in Figure 10.

Defining What Customers Value

Exercise

Identify and prioritize any unique customer demands and give them the attention they deserve



Figure 10. Customer value form.

5.2. Waste

Waste refers to any activity or process that does not add value to the product or service and should be eliminated or minimized.

To do this, you need to develop “eyes for waste” in order to see the waste on your farm and within your current farm processes.

There are eight types of waste. They are easily remembered using the acronym DOWNTIME, which stands for Defects, Overproduction, Waiting, Not utilizing people, Transportation, Inventory, Motion, and Extra processing.

- **Defects** refer to any errors or mistakes during the production process that results in products that do not meet the requirements of the customer. For example, in small-scale fish farming, defects could include fish that are of poor quality or fish that are damaged during transportation or handling.
- **Overproduction** occurs when more fish are produced than are needed or can be sold. This can lead to excess inventory and waste, as well as increased costs associated with storage and handling. In addition, excessive feeding in ponds can produce too much biomass, causing the water to turn heavily green and depleting the oxygen in the water.
- **Waiting** refers to periods of inactivity or delays during the production process, which can waste time and resources. For instance, in small-scale fish farming, waiting can happen if fish are not harvested or processed promptly, leading to spoilage or degradation of quality. Waiting can also occur when farmers wait for feed, feed ingredients or technical repairs for their pond facilities.
- **Not utilizing people** applies to any situation where workers are not fully engaged or used in the production process, leading to wasted time and resources. In small-scale fish farming, this can occur if workers are not adequately trained or equipped to perform their jobs, resulting in inefficiencies and errors.
- **Transportation** waste is any unnecessary movement of products or materials that adds time and cost to the production process. In small-scale fish farming, transportation waste occurs if fish are moved between multiple locations unnecessarily or if inefficient

transportation methods are used. For instance, carrying feed bags one by one is less efficient than using a trolley to transport many loads simultaneously.

- **Inventory** waste applies to any excess inventory that is not needed or cannot be sold. In small-scale fish farming, this occurs when too many fish are produced or when storage and handling methods are inefficient, leading to spoilage or loss of quality.
- **Motion** waste is any unnecessary movement or motion in the production process that adds time and cost. In fish farming, motion waste occurs when workers travel long distances to perform their jobs or use inefficient handling methods. For instance, locating feed in storage far away from the fishpond causes excessive motion in getting the feed and returning it to the pond.
- **Extra processing** refers to any unnecessary steps or processes in production that do not add value. For example, in small-scale fish farming, excess processing waste occurs when fish are processed or handled in unnecessary or inefficient ways.

These eight nearly invisible wastes steal time and money throughout your farm. But did you know that by being aware of DOWNTIME, you can easily spot areas of waste on your farm or within your processes? It's true! Armed with this knowledge, you can take proactive steps to reduce or even eliminate these wastes altogether, saving you money and adding time back into your day.


It's time to practice identifying your waste in the template in Figure 11. It might be helpful to take a walk around your farm, opening your eyes and searching for waste that is sometimes in plain sight but has been invisible previously. We call this having new “eyes for waste.” Now, go spot waste with your new eyes!

By eliminating waste and focusing on creating value, lean management helps organizations increase efficiency, reduce costs, improve quality and enhance customer satisfaction. This approach emphasizes the importance of understanding customers' needs and requirements, designing processes to meet those needs, and continuously improving those processes to meet customers' changing demands.

Implementing lean management principles in fish farming can have significant benefits for a farm's efficiency, productivity and profitability. The key to success is understanding what customers value and eliminating any waste in the production process. Value is determined by customers' needs and requirements, such as freshness, quality, size, cleanliness, price and convenience. Waste, on the other hand, is any activity or process that does not add value to the product or service and should

be minimized or eliminated. By being aware of the types of waste in DOWNTIME, you can take proactive steps to reduce or eliminate these wastes, saving both time and money. Overall, the lean management approach emphasizes continuous improvement and meeting customers' changing demands, leading to increased efficiency, reduced costs, improved quality and enhanced customer satisfaction.

8 Wastes Exercise



D	Defects/ Rework	
O	Overproduction	
W	Waiting	
N	Not Utilizing People	
T	Transportation	
I	Inventory	
M	Motion	
E	Extra Processing	

Figure 11. 8 Wastes Exercise.

Small-Scale Fish Farm Waste Examples

D	Defects/ Rework	<ul style="list-style-type: none"> • Fish feed bags with holes or tears • Diseased or unhealthy fish in the pond • Broken feeding equipment that needs repair
O	Overproduction	<ul style="list-style-type: none"> • Producing more fish than the market can handle, resulting in excess inventory • Overfeeding fish, leading to wastage of fish feed and potential water pollution
W	Waiting	<ul style="list-style-type: none"> • Farm workers waiting for the fish feed delivery • Fish waiting to be harvested due to a lack of processing equipment • Fish farmers waiting for feedback or approvals from buyers
N	Not Utilizing People	<ul style="list-style-type: none"> • Workers not trained to operate all equipment, leading to equipment downtime • Underutilizing experienced staff who could offer suggestions for improvement • Assigning tasks that don't match employees' skill levels
T	Transportation	<ul style="list-style-type: none"> • Transporting fish feed from a far-off location instead of sourcing it locally • Transporting harvested fish to a processing facility located far away • Making multiple trips to deliver fish to different buyers
I	Inventory	<ul style="list-style-type: none"> • Stockpiling fish feed in large quantities, leading to spoilage or waste • Maintaining excessive fish inventory in the pond, leading to overcrowding and potential fish loss • Stockpiling harvested fish without a confirmed buyer, leading to potential waste or loss
M	Motion	<ul style="list-style-type: none"> • Farm workers moving back and forth to retrieve fish feed, leading to inefficiency • Walking long distances to perform tasks, leading to time wastage • Bending down to reach fish in low ponds, leading to physical strain and potential injury
E	Extra Processing	<ul style="list-style-type: none"> • Adding unnecessary steps in the feeding process, such as extra screening of fish feed • Performing additional treatments on the fish without justification, leading to waste of resources • Overprocessing fish for a specific buyer's requirements, leading to unnecessary expense

Figure 12. Examples of waste on small-scale fish farms.

6. Turbocharge farm efficiency

Now that you are ready to take action and remove the waste on your farm, it's time to introduce a lean management implementation methodology called a rapid improvement event (RIE).

6.1. Rapid improvement event

An RIE is a focused and intense team effort to solve a specific problem or improve a targeted process within a short period of time, typically lasting a few days or a week. The event brings together a cross-functional team to analyze the current state of the target process, identify areas of improvement and develop and implement solutions. The event involves identifying opportunities for improvement, engaging employees in the improvement process and using data to measure the effectiveness of changes.



There are seven steps in an RIE:

1. **Define the problem or opportunity for improvement:** Clearly define the issue or process that needs improvement and establish measurable goals for success.
2. **Assemble a team:** Build a cross-functional team of individuals with diverse skills and perspectives who can help identify the root cause of the problem and develop effective solutions.
3. **Analyze the current state of the target process:** Collect data and analyze the current process to identify areas of waste, inefficiencies, and opportunities for improvement.
4. **Develop and test potential solutions:** Brainstorm and evaluate potential solutions, and then test them to see if they address the root cause of the problem.
5. **Implement and standardize:** Once a solution has been identified and tested, implement it and create standard work procedures to ensure consistency and sustainability.
6. **Monitor and measure:** Monitor the new process continuously to measure its effectiveness and identify any areas needing further improvement.
7. **Celebrate success:** Celebrate and recognize the team's hard work and success in achieving the goals of the RIE. This helps build momentum and support for further continuous improvement efforts.

For Mary, she is a go-getter. She's motivated and takes the initiative to have conversations with her customers, ensuring she fully understands their needs and desires to provide them with the utmost value.

The problem Mary needs to address is the high cost of feed. She has 5000 fish in each of her ponds, for a total weight of 1000 kg. Mary uses Bob's Brand of sinking feed that she gets in town, and she feeds the fish in each pond 40 kg daily, which costs USD 1.25/kg for a total of USD 100 per day or USD 18,000 for a 6-month cycle per year. Mary also eagerly looks forward to implementing the RIE method on her farm to achieve her goals.

6.2. RIE Step 1

To begin the process of improvement, it is essential to define the problem or opportunity clearly. This involves identifying the issue or process that needs improvement and setting measurable goals for success.

Define the problem or opportunity for improvement:

Clearly define the issue or process that needs improvement and establish measurable goals for success.

6.2.1. Mary's farm

In Mary's case, she and her team identify the problem as the need to optimize feed use and the feeding process to reduce feed costs by 20 percent. By defining this problem and setting a specific goal, Mary and her team can focus their efforts and develop a plan of action to achieve their desired outcome. With a clear understanding of the problem and a measurable goal in place, they can now move forward with confidence and purpose.

6.3. RIE Step 2

To effectively identify the root cause of a problem and develop practical solutions, it's essential to assemble a cross-functional team of individuals with diverse skills and perspectives.

Assemble a team: Create a cross-functional team of individuals with diverse skills and perspectives who can help identify the root cause of the problem and develop effective solutions.

6.3.1. Mary's farm

For this purpose, Mary carefully assembles an RIE team that consists of herself, one employee and three experienced farmers. Her team is well equipped to collaborate and work toward achieving the goals of the RIE. It's worth noting that the optimal team size is usually five to six people. Mary's team falls within this range, so it makes it easier for them to work together efficiently.

6.4. RIE Step 3

In the third step of the RIE process, the team must analyze the current state of the target process by collecting data and identifying areas for improvement.

Analyze the current state of the target process:

Collect data and analyze the current process to identify areas of waste, inefficiencies, and opportunities for improvement.

6.4.1. Mary's farm

To prepare for this step, Mary gathers her tools, which include a VSM of the feeding fish process, a spaghetti diagram layout of her farm, and 8 Wastes DOWNTIME forms for each team member. The VSM helps visualize the current process, the spaghetti diagram provides a clear understanding of the physical layout of the farm, and the 8 Wastes DOWNTIME form is used to identify areas of waste and inefficiencies. With these tools in hand, Mary and her team can analyze the current state of the target process and determine where to make improvements.

The RIE team gathers together and observes Mary's employee perform the fish feeding process on her farm. As they watch, team members take photos, capture motion on the spaghetti diagram, time the process steps, measure the distance traveled, identify wastes and take notes. As shown in Figures 13 and 14, they update the VSM with process time information and draw the spaghetti diagram to show the movement of the worker who is performing the fish feeding process.

Spaghetti Diagram - Mary's Farm

Rough hand sketch of the farm layout

Current State

Distance traveled - 100 m

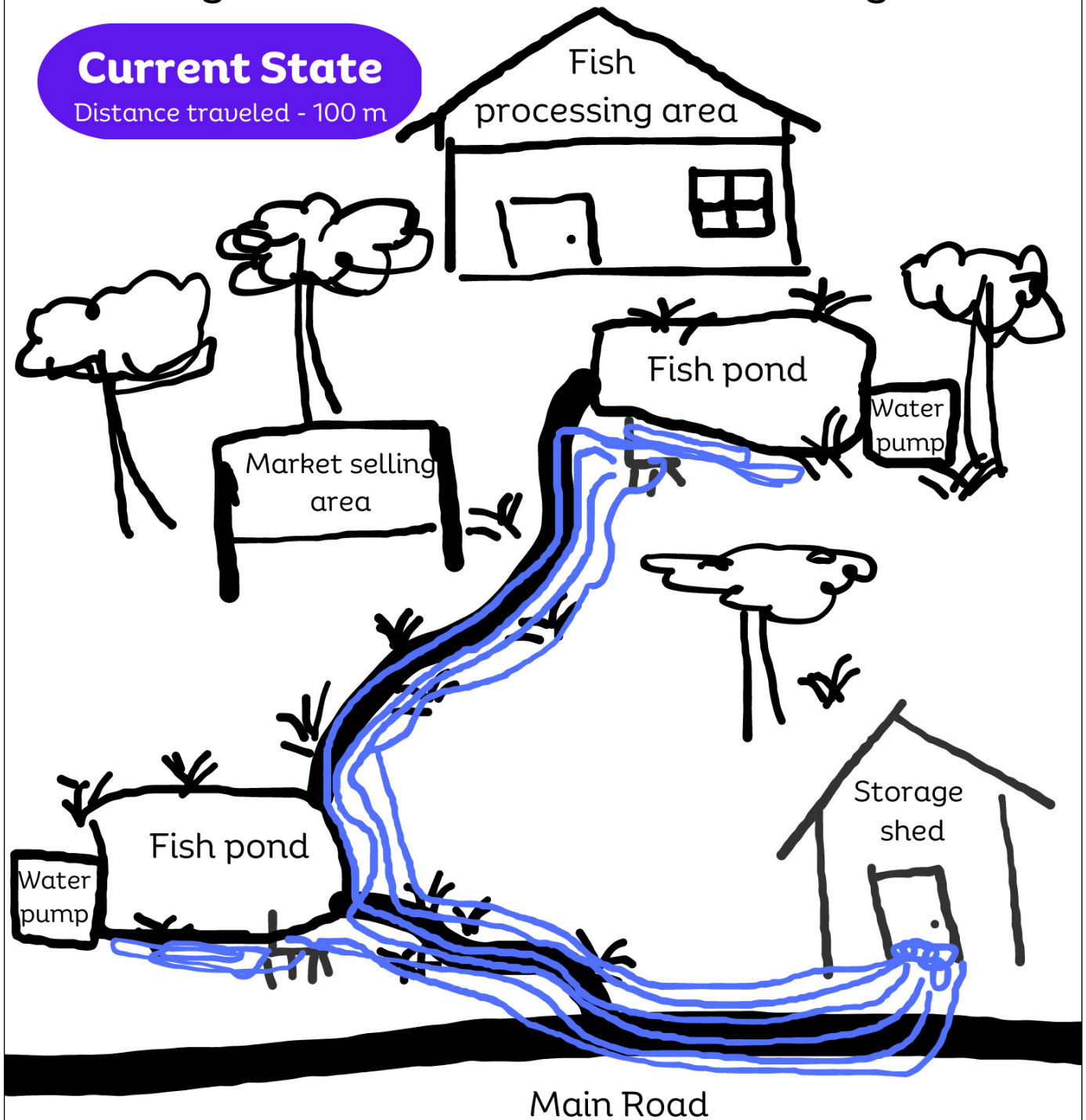


Figure 13. Updated spaghetti diagram for Mary's farm.

Value Stream Mapping - Mary's Farm

Fish Feeding Process - Current State

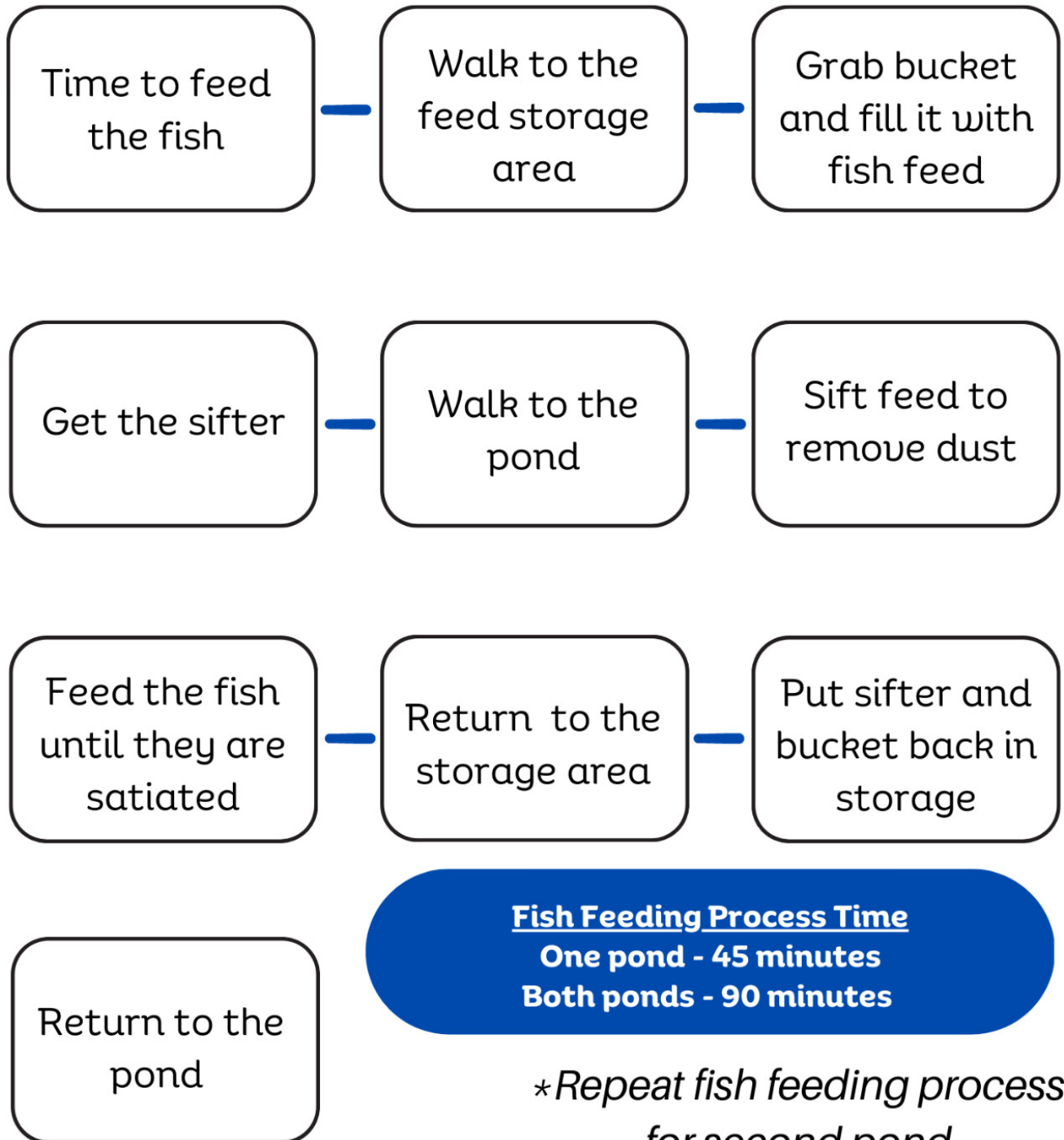


Figure 14. Updated VSM for Mary's farm.

After observing the feeding process, the team analyzes the data they've collected, asks the worker questions for clarification and discusses significant issues and opportunities. The group reviews all the information and identifies the crucial areas to address. Next, the team revisits their initial RIE objective, which is to optimize feed use and the feeding process and reduce feed costs by 20 percent. Finally, after reflecting on their lean management tools and having discussions, the team prioritizes the issues and opportunities based on their impact on their goal.

The team decides to concentrate on the following three areas:

1. Farm layout using the spaghetti diagram tool

- The feed bags are located in the storage shed, far away from the ponds.
- There is a lot of excess motion and travel in the feeding process.

2. Feed process using the VSM tool

- Feeding takes longer than it should.
- The distance traveled to retrieve and distribute feed bags is excessive.
- The employee lacks proper knowledge of satiation from sinking feed.
- The fish are not interested in the feed, so they are not eating aggressively, leading to reduced feeding response.
- There are dead fish floating in the water.
- The water is green, cloudy and smells foul.
- Water pump is running constantly, using up too much fuel.

3. The 8 Wastes DOWNTIME form

- There are people who are not doing much, so their knowledge and experience are not being put to good use.
- There is too much movement during the fish feeding process.
- Transporting the feed during the fish feeding process takes too long.

Mary's team will continue the RIE steps in the upcoming chapters.

To sum up, an RIE is a focused and intense team effort to solve a specific problem or improve a targeted process within a short period of time. It is a lean management implementation methodology that brings together a cross-functional team to analyze the current state of the target process, identify areas of improvement, and develop and implement solutions. The process is designed to quickly and efficiently improve productivity, reduce waste, increase profitability and create a culture of continuous improvement. Overall, by implementing lean management principles and using an RIE, farmers can make quick and impactful improvements on their farms.

7. Get the roots out

Are you ready to take your farm to the next level? It's time to leave behind the monotony of the past and embrace a fresh approach that will yield amazing results. And the good news is, this guide will walk you through how to do it. So get ready to break free from the past and achieve the results you've been dreaming of!

Root cause analysis (RCA) is a crucial problem-solving tool for farmers looking to improve their farm's efficiency and productivity. By identifying the underlying cause of a problem, farmers can take the necessary steps to address the root cause and prevent the problem from reoccurring. So, if you want to improve your farm's performance, try getting to the root of your farm's problems.

Don't worry, you don't have to do it alone. This guide is your ultimate companion to achieving the success you've been yearning for. We'll start by diving into RCA. Then we'll take you on a journey through the implementation steps that will guide you through the changes you need to make on your farm.

7.1. Root cause analysis

Once you've thoroughly reviewed all the information and observed your farm's processes, it's time to get to the heart of the critical issues. Gaining a deeper understanding of these issues will enable you to find quick and effective solutions. Armed with this knowledge, you'll find that taking action and solving problems on your farm becomes a breeze.

When it comes to problem-solving on your farm, here's a valuable tip: take the time to uncover the root cause of the issue. It might take some extra effort, but it's well worth it. Dealing with the symptoms or surface-level problems might provide temporary relief, but it's unlikely to solve the issue over the long term. However, pinpointing and addressing the root cause will help prevent the problem from reoccurring and lead to more sustainable solutions. Plus, by focusing on the root cause, you'll save time and resources by avoiding ineffective or unnecessary interventions. So, dive into an RCA and identify those underlying issues

that have been holding you back. Then, you can create a plan to overcome them and take your farm to a higher level of performance.

If you're struggling to identify the root cause of a problem on your farm, the 5 Why technique may be the answer you've been looking for. This methodology involves asking "why" questions repeatedly until you uncover the underlying cause of the issue. By digging deeper and going beyond the surface-level symptoms of the problem, you can identify the fundamental reason behind it and take the necessary steps to address it. With the 5 Why approach, you can unravel even the most complex issues and find effective solutions that stick.

The 5 Why process works as follows:

1. **Define the problem:** Clearly define the problem that needs to be solved.
2. **Ask "why?" five times:** Ask "why" to determine the cause of the problem. Each answer leads to another "why" question until the root cause is identified. Generally, five "whys" are enough to identify the cause, though it might take more or less.
3. **Identify and implement solutions:** Once you identify the root cause, brainstorm potential solutions to address it. Then, implement the most effective solution(s) and monitor for improvement.

The best way to become familiar with this method is to see a couple of examples and get the rhythm of how it flows. Follow how to use the 5 Why method in Figure 15.

5 Why Example - Poor Water Quality

WHY?

Problem: The water quality in the fish pond is poor.

Why is the water quality poor?

The water looks cloudy, and there is an odor.

Why is the water cloudy and odorous?

There is a buildup of organic matter in the pond.

Why is there a buildup of organic matter in the pond?

The fish feed is only partially consumed by the fish, leading to excess waste and uneaten feed.

Why is the fish feed not being fully consumed?

The fish are not being fed the correct amount of feed.

Why are the fish not being fed the correct amount of feed?

There is no system in place to accurately measure and distribute the correct amount of feed.

Figure 15. Example of the 5 Why method.

In this example, you can see that the root cause is the lack of a system to accurately measure and distribute the correct amount of feed. This leads to excess waste and uneaten feed, which in turn results in poor water quality from a buildup of organic matter.

Here is another 5 Why example related to slow fish growth:

Problem: The fish are growing slower than expected.

1. Why are the fish growing slower than expected?
They seem to be eating less.
2. Why are the fish eating less?
They do not like the feed.
3. Why do they not like the feed?
We are using low-quality ingredients.
4. Why are we using low-quality ingredients?
They are less expensive, and we are trying to keep our costs down.
5. Why are we trying to keep our costs down?
We are not making enough profit from selling the fish, so we need to reduce our expenses.

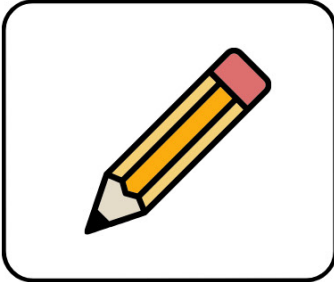
In this example, you can see that the root cause of the problem is the need to lower expenses, which leads to using low-quality ingredients in the fish feed. However, to address the issue of slow fish growth, the farmer may need to consider using higher-quality ingredients in the feed, even if they are more expensive, to improve the fish's overall health and growth. In this case, one potential strategy to consider is investing in a short-term expense that could result in bigger and healthier fish, leading to higher revenues in the long run.

Now it's your turn. Select a problem, and go through the steps in 5 Why process in Figure 16 to practice getting to the root cause(s). This is another skillset you can learn to help you improve your farm.

The 5 Why method is a powerful, root cause technique that can reveal the underlying cause of a problem. By asking "why" questions repeatedly, you go beyond the symptoms and find the fundamental reason behind the issue. Once you identify the root cause(s) of a problem, you can use that information to determine the actions needed to resolve it.

The key to taking your farm to the next level lies in adopting a fresh approach that prioritizes problem-solving and efficiency. By using tools such as an RCA, you can identify and address the underlying causes of your farm's problems, paving the way for increased productivity and success. To that end, this guide is an essential resource for farmers who are ready to break free from the monotony of the past and achieve the results they've been dreaming of. Whether you're just starting out or looking to improve your farm's performance, the implementation steps outlined in this guide will guide you toward the changes you need to make to take your farm to new heights.

5 Why Template



Problem: _____



Note: It may take more or less than 5 Whys to get to the root cause. Typically, between 3 and 7 Whys will get you to the root cause of the problem.

Figure 16. The 5 Why method.

8. Let's do it

The next step is where the real excitement begins. This is the point in an RIE where you get to brainstorm, analyze, try out and evaluate your chosen solutions focused on addressing the root causes of problems.

In this example, Mary and her team have already completed the first three steps of the RIE process. They are now ready for the fourth step: to develop and test potential solutions. They have grouped the issues on Mary's farm into five categories and have found that fish feed and the feeding operation is causing most of the issues. The team has come up with creative solutions to address these problems, and they are eager to implement and test them to see if they work. In this chapter, we will learn about Mary's team's proposed solutions and how they plan to test them to achieve measurable goals for success. So let's dive in!

8.1. Making change

You probably have many exciting ideas you can't wait to try. This is the time to do just that. You want to continue using the RIE steps, as they will help you stay on the right path to creating impactful change that lasts.

Let's watch Mary and her team follow the next RIE step to make improvements.

Mary's team has already completed RIE steps 1–3 and is ready to take on step 4.

RIE Step 1 (Complete):

Define the problem or opportunity for improvement:

Clearly define the issue or process that needs improvement and establish measurable goals for success.

- Mary has defined her issue and measurable success as follows: optimize feed use and the feeding process to reduce feed costs 20 percent.

RIE Step 2 (Complete):

Assemble a team: Create a cross-functional team of individuals with diverse skills and perspectives who can help identify the root cause of the problem and develop effective solutions. Pro tip: the optimal size for a team is five or six people.

- Mary has assembled an RIE team that consists of herself, one employee and three experienced farmers.

RIE Step 3 (Complete):

Analyze the current state of the target

process: Collect data and analyze the current process to identify areas of waste, inefficiencies, and opportunities for improvement.

- To help with this step, Mary has collected her lean tools and made copies of the steps in the value stream mapping process, the layout of her farm, and the 8 Waste form for each team member. Her team has observed, analyzed and identified areas of opportunity for the feeding process.

8.2. RIE Step 4

Develop and test potential solutions:

Brainstorm and evaluate potential solutions, and then test them to see if they address the root cause of the problem.

8.2.1. Mary's farm

Eager to start making changes, Mary's RIE team has categorized the problems on the farm into five categories: fish feed product, fish feed process, poor water quality, excessive water pump use, and fish mortality. It has become quickly apparent to the team that the fish feed and feeding operation have caused multiple issues on the farm. With the information they have gathered, along with their experience and a little research, Mary and her team have generated solutions to test and implement.

8.3. Problems and corrective actions

8.3.1. Fish feed

The team has focused on fish feed issues and identified two primary problems: overstocking and poor quality. The feed has been overstocked in the storage shed to avoid extra trips to purchase feed in town. This has led to several issues: the feed has rotted, it is infested with pests, and there are holes in the feed bags, causing spillage and feed loss. Poor feed quality is also the root cause in multiple problems. The feed is traditional

sinking feed, so it is difficult to see how much feed the fish are consuming compared to how much sinks to the bottom of the pond. In addition, the binding agent in the feed is weak, causing the feed to break apart and creating significant amounts of dust in the feed. As a result, the dust has to be filtered and separated before feeding the fish. This wastes a considerable amount of feed, creating an extra step in the processing because the employee has to sieve the dust. It is also apparent that the fish do not like the feed, so they are eating less and thus growing slower.

After analyzing the problem and brainstorming solutions, the team generated several actions to address the issues of overstocked and poor quality feed and then tested them. The first solution is to buy feed from the retail shop across from the farm, which offers floating feed with nutrition labels. This approach provides quick and easy access to feed, eliminating overstocking and improving feed quality. Despite the slightly higher price, Mary believes the long-term benefits of using better feed will offset the increased cost.

8.3.2. Fish feeding process

The team members have now shifted their attention to the process of feeding the fish. Upon observation, they have discovered excessive motion and transportation waste in moving feed from the storage shed to the ponds for each feeding. They have also noted additional processing waste in removing dust from the feed before feeding the fish. Overfeeding the fish until they are satiated results in wasted food sinking to the bottom of the pond.

To address these issues in the process, the team has devised low-cost and creative solutions. Their initial step is to place a feed tub next to each pond and directly stock it with fish feed bought from the local source. This will eliminate the need to store feed in the shed, which in turn will eliminate excessive motion and transportation and the expenses incurred in overstocking. Furthermore, the superior quality feed will bind efficiently, removing the additional process of having to remove dust before feeding. Lastly, the team's ingenious and simple solution to prevent overfeeding is to use a plastic bucket marked with a line to show the amount of feed needed to feed the fish.

8.3.3. Poor water quality

The team has identified poor water quality as an issue in both ponds because of cloudy water and an unpleasant odor. However, they believe several previously implemented improvements will address this problem. First, using the feed measurement system will ensure that the correct amount of feed is distributed in the water, reducing excess feed that can decompose on the pond bottom and feed the biomass. Second, the high-quality floating feed has an effective binding agent that will reduce feed waste in the water and allow the employee to monitor feed consumption easily. These two solutions will work together to keep the water cleaner.

8.3.4. Excessive water pump use

Excessive use of the water pump is another issue the team has identified. Both water pumps operate 8 hours a day to clean the water in the ponds. This is expensive and causes equipment wear, leading to maintenance issues. The team believes that improving the water quality in the ponds will reduce the use of the water pump significantly, from 8 hours down to 4 daily. Furthermore, they have discussed the possibility of connecting the two ponds with plastic piping to operate both with just one pump in the future to save equipment. They will also provide a backup water pump in case of breakdowns.

8.3.5. Fish mortality

During the feeding process, the team saw dead fish floating in the ponds. However, they remain optimistic that the changes they have already implemented will address this issue. For example, using high-quality floating feed and improving the water quality are expected to decrease the mortality rate dramatically. As a result, the fish will be healthier overall, and mortality will be reduced.

8.3.6. Underutilized employee

Not using people efficiently is a critical waste captured on the 8 Wastes DOWNTIME form. Here are some examples to help you spot this elusive waste:

- Employees with relevant skills and expertise are not given tasks that use their full potential.
- Employees are not given sufficient training and resources to improve their skills and knowledge.

- Employees are not given enough opportunities for career development and growth within the organization.
- Employees are not given clear job responsibilities and expectations, leading to confusion and lack of productivity.
- Employees who are not motivated or engaged develop low morale and thus reduced productivity.

In Mary's case, she realizes she needs to train and delegate more responsibilities to her employee. As a result, the employee could be more engaged and motivated, as Mary is overloaded with farm tasks.

Here are six solutions to consider to improve the use of your employees:

1. **Cross-training:** Training employees to perform different tasks can improve their skillset and increase their value to your farm. For example, a fish farm worker trained in fish feeding and water quality management can easily switch between the two tasks, depending on the needs of your farm.
2. **Task rotation:** Rotating personnel among different tasks can help prevent monotony and boredom while improving overall productivity. For example, an employee in charge of feeding fish can be rotated to help with netting or harvesting.
3. **Specialization:** Some employees might have specific skills or interests that you can use to improve the efficiency of your farm. For example, an employee who is particularly skilled in fish health management can be given additional responsibilities in this area.
4. **Increased responsibility:** Giving employees more responsibility can increase their motivation and job satisfaction. For example, an employee responsible for cleaning and maintaining a fish tank can be given additional responsibilities, such as monitoring water quality or fish health.
5. **Automation:** Automating certain tasks, such as feeding the fish or monitoring water quality, can free employees to focus on other essential tasks, such as fish health management or farm maintenance. This can also improve the accuracy and consistency of these tasks.

6. **Strengths, interests and opportunities:**

Overall, the key to using personnel on a fish farm better is to identify their strengths and interests and provide opportunities for growth and development within the farm.

For her part, Mary has immediately increased her employee's responsibilities and created a plan with the employee for cross-training.

8.3.7. Customer improvement

Mary and her team have found joy in solving problems and taking action to improve her farm, and they feel good about the progress they've made. As a result, Mary is inspired to address one more issue that her customers have brought up: the inconvenience of having to travel long distances on her farm to buy fish. Previously, her customers had to trek all the way from the road to the back of her farm to buy her fish and then carry the fish all the way back to their vehicles. Recognizing that this is a drain on the time and energy of her customers, Mary has relocated the marketing and sales area next to the road. This will make it more accessible and convenient for customers, providing them with even greater value.

Taking action to solve problems is what it's all about. With the RIE method, you have a powerful tool that can help you and your team identify problems, develop effective solutions and create dramatic results that last. For Mary and her team, using the RIE process focused their efforts on optimizing feed use and the feeding process and reducing feed costs by 20 percent. The team then proceeded to the fourth step: developing and testing potential solutions. First, the team grouped the problems on Mary's farm into five categories and identified fish feed and the feeding operation as the primary issues. Next, they generated several solutions to address these issues, such as buying better feed, eliminating feed storage in the shed, and using a plastic bucket marked with a line to prevent overfeeding. By implementing these solutions, the team was able to reduce motion and transportation waste, overstocking expenses, and feed waste, resulting in significant cost savings and improved water quality.

9. Leap to the next level

Fantastic work! It's great to see how much progress you've made in developing and testing solutions to improve your farm operations. Next, you will take the leap and officially implement the improvements and lock them down through standardization. So, let's get to it and take your farm operations to the next level.

9.1. RIE Step 5

Congratulations, it is time to officially implement improvements in the process as part of normal operations.

Implement and standardize: Once you have identified and tested a solution, implement it and create standard work procedures to ensure consistency and sustainability.

Once you have tested and refined the new process, the next step is to standardize it. Standardizing activities and creating procedures provide a clear framework for performing tasks such as feeding, water quality testing and disease prevention. Standards help minimize mistakes and reduce the risk of errors that can lead to poor fish health or low yields. This is done to ensure consistency and quality across the farm. Standards also help farms comply with regulations and standards for food safety and environmental sustainability.

Standard operating procedures (SOPs) are developed to document the new process and provide clear instructions for everyone involved. The team members are then trained on the new process and SOPs so that they fully understand the changes and can perform their roles effectively. Continuous improvement is also a vital aspect of the process. It involves ongoing monitoring and improvement of the new process to maintain effectiveness and efficiency over time. By continuously improving the process, a farm can remain competitive and meet the changing needs of its customers. By following SOPs, a farmer can optimize production, maintain the health of their fish and improve the operation's overall profitability.

To start standardizing, we need to go back to where we started. Remember how you initially

captured your existing processes using the VSM and the spaghetti diagram tools? What you want to do next is take those tools and create new versions that reflect the improvements. The updated tools will give you a clear representation of the new processes and make it easy to compare "before" and "after" changes.

9.1.1. Mary's farm

Let's look at the VSM and spaghetti diagrams for Mary's farm before and after the fish feeding process, as shown in Figures 17–20.

9.2. Standards: Documenting procedures

You want to make sure that the new process is clear to employees, so it is necessary to create SOPs and other documents that reflect the expected activities and roles associated with the new processes.

The team on Mary's farm has created standards to support the new fish feeding processes.

9.2.1. Fish feeding process and responsibilities

1. Use proper management to supply high-quality feed.
2. Locate good quality feeds directly inside the feed tub beside each pond.
3. Feed the fish twice daily, in the morning between 08:30 and 09:30 and the evening between 17:00 and 18:00.
4. Avoid overfeeding the fish by feeding them the specified quantity daily and at the right time, as overfeeding can lead to poor water quality, disease outbreaks and increased costs.
5. Keep the remaining feed in tubs with lids to prevent rodent infestation and spoilage.
6. Ensure the fish feed is high quality and store it properly in the feed tub to prevent spoilage.
7. Monitor the fish's growth rate and adjust the feeding schedule and amount as needed.
8. Feed the fish at the same time and in the exact location each day to help them establish a feeding pattern.

9. Keep a record of the feeding schedule, amount of feed given and rate of fish growth for future reference.

Tracking feeding is one of the requirements in the fish feeding process, so it is necessary to provide another standard for recording fish feeding.

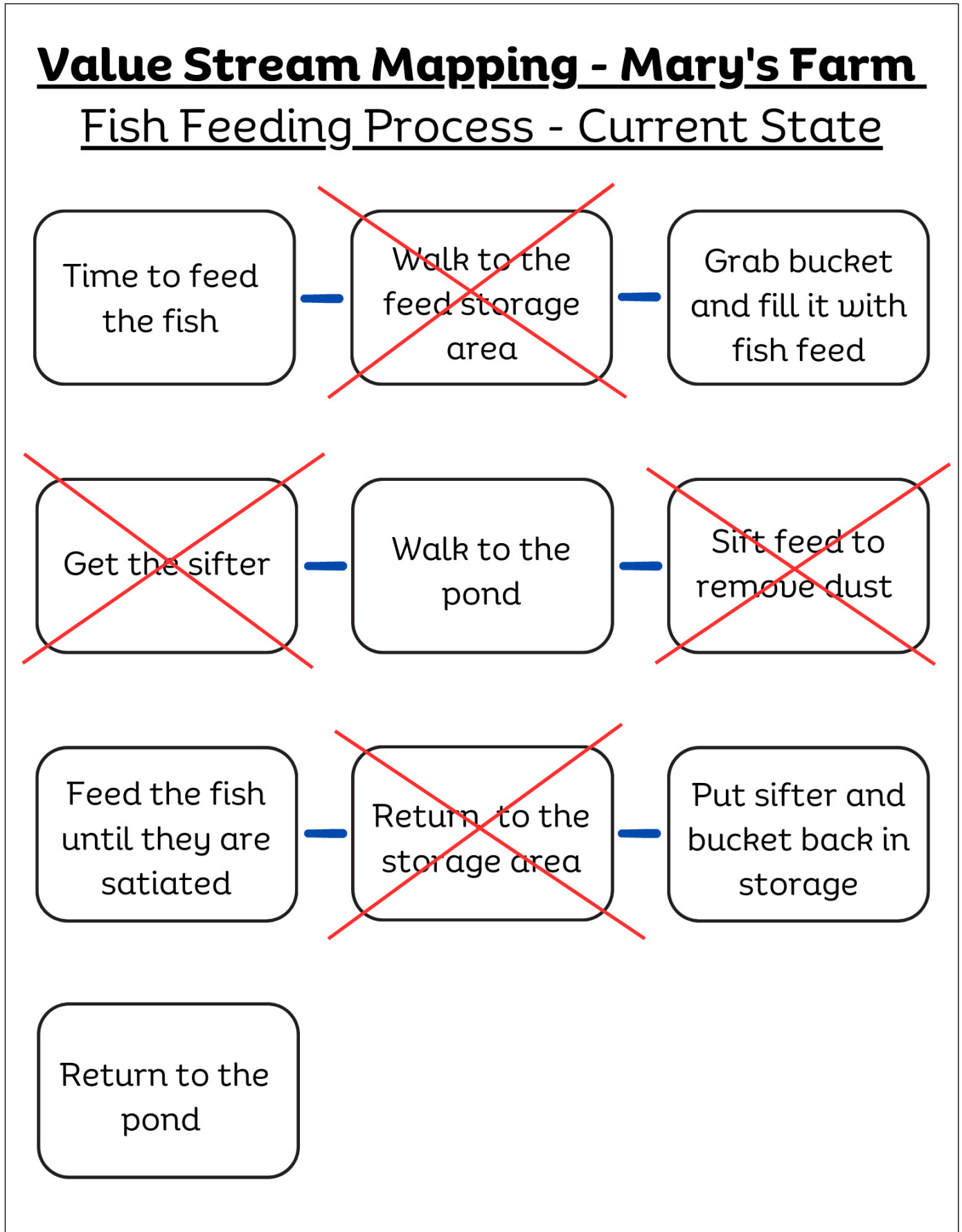
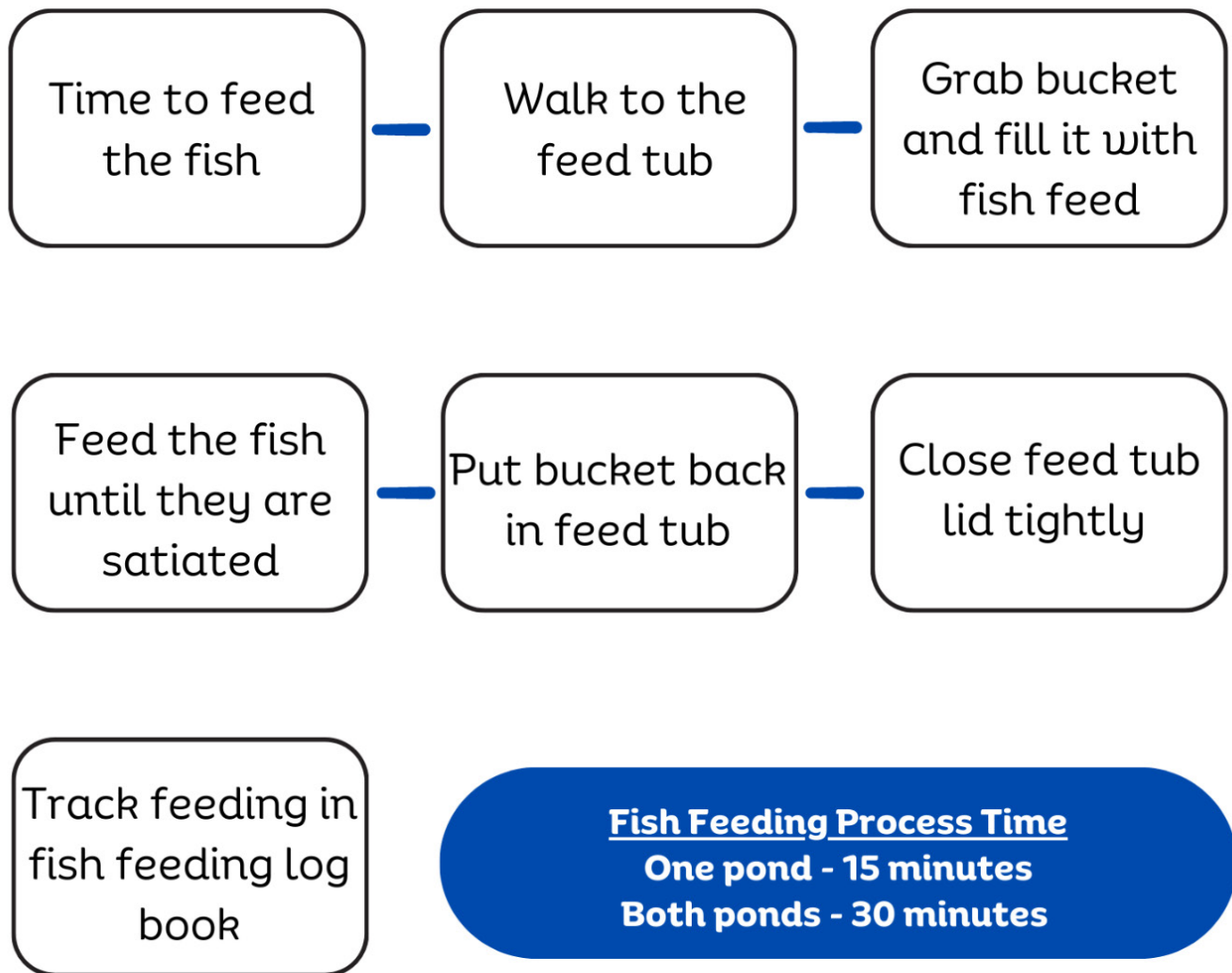


Figure 17. VSM for Mary's farm on the current state of the fish feeding process.

Value Stream Mapping - Mary's Farm

Fish Feeding Process - Future State



**Repeat fish feeding process for second pond*

Figure 18. VSM for Mary's farm on the future state of the fish feeding process.

Spaghetti Diagram - Mary's Farm

Rough hand sketch of the farm layout

Current State

Distance traveled - 100 m

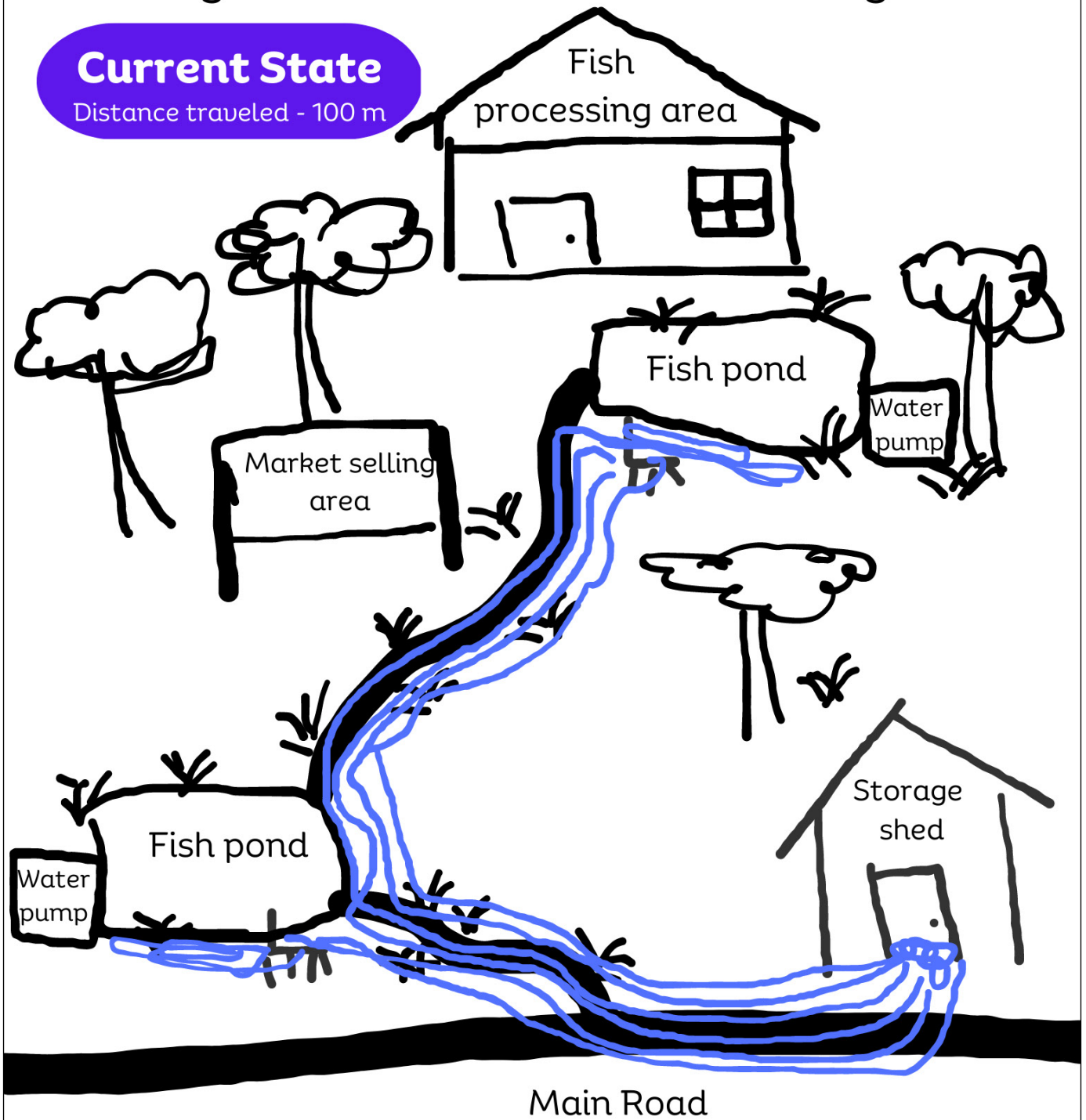


Figure 19. A spaghetti diagram of the current state or process movement of Mary's farm.

Spaghetti Diagram - Mary's Farm

Rough hand sketch of the farm layout

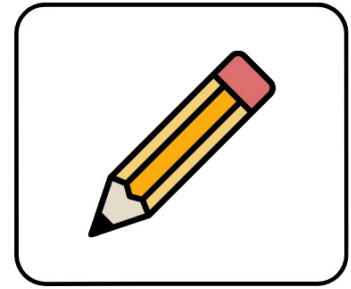
Future State

Distance traveled - 20 m



Figure 20. A spaghetti diagram of the future state or process movement of Mary's farm.

Fish Feeding Log Template



Date	Time	Water Temperature	Dissolved Oxygen	pH Level	Ammonia Level	Nitrite Level	Observations	Actions Taken

Figure 21. Fish feeding log.

Fish Feeding Log Example

Date	Time	Water Temperature	Dissolved Oxygen	pH Level	Ammonia Level	Nitrite Level	Observations	Actions Taken
12/4/2023	8:30 am	26°C	6.5 mg/L	7.2	0.2 mg/L	0.1 mg/L	Fish feeding well, clear water.	None.
12/4/2023	5:20 pm	24°C	6.2 mg/L	7.1	0.3 mg/L	0.2 mg/L	Some uneaten feed on the surface and fish seem active.	Reduced feed amount.
13/4/2023	8:45 am	25°C	6.3 mg/L	7.3	0.4 mg/L	0.3 mg/L	Water is slightly cloudy; fish are less active than usual.	Increased aeration.
13/4/2023	5:15 pm	23°C	5.8 mg/L	7.0	0.5 mg/L	0.4 mg/L	Water is heavily discolored, and fish not feeding.	Water exchange and added bacteria to reduce ammonia level.
14/4/2023	9:00 am	24°C	7.0 mg/L	7.2	0.2 mg/L	0.1 mg/L	Water clear, fish feeding well.	None.
14/4/2023	5:45 pm	25°C	6.4 mg/L	7.1	0.3 mg/L	0.2 mg/L	Water is slightly discolored; fish seem lethargic.	Increased water exchange and added oxygen.

Figure 22. Example of a fish feeding log.

It is essential to regularly monitor and record water quality parameters to identify any issues and take appropriate actions. Feeding records help farmers keep track of the feeding schedule and amount of feed given to the fish, as well as log any remarks or observations that could impact their growth and health. Farmers can use this information to make informed decisions about adjusting the feeding schedule or amount of feed, as well as to detect any irregularities or issues that arise.

Consistently maintaining water quality on the farm is crucial. To achieve this, it's vital to establish SOPs for checking the water quality.

9.2.2. Water quality monitoring process and responsibilities

1. Conduct a visual inspection of the water for any signs of discoloration, odor or debris.
2. Measure the water temperature using a thermometer. The optimal temperature range is typically between 24°C and 30°C.
3. Measure the dissolved oxygen (DO) level using a DO meter or test kit. The DO should be at least 4 ppm.
4. Test the pH of the water using a pH meter or test kit. The optimal pH range for catfish is typically between 6.5 and 7.5.

5. Measure the ammonia and nitrite levels in the water using a test kit. The ammonia level should be less than 0.5 ppm, and the nitrite level should be less than 0.2 ppm.
6. Record the measurements and observations in a logbook or spreadsheet for future reference and to track changes over time.
7. Take corrective actions if water quality parameters are outside the optimal range, such as adjusting the feeding rate, increasing aeration or water exchange, or treating the water for diseases or parasites.

Note: Monitoring water quality parameters is essential to maintain optimal conditions for fish growth and health and to prevent disease outbreaks and mortality.

Performing the water quality monitoring process maintains the water quality in the fishpond at an appropriate level for the growth and health of the fish. Regular water quality monitoring allows farmers to identify issues early and take corrective action before they escalate into more significant problems that could negatively impact fish growth and health.

As mentioned in the water quality monitoring process steps above, recording the water quality measurements and observations is one of the requirements of the fish feeding process. As such, it is necessary to create this standard as well.

Date	Time	Water temperature (°C)	Dissolved oxygen (ppm)	pH level	Ammonia level (ppm)	Nitrite level (ppm)	Observations	Action taken
Apr. 12, 2023	10:00	27	6.0	7.2	0.2	0.1	Water is clear with no visible debris or odors. Fish are active and feeding well.	None
Apr. 15, 2023	14:00	29	4.5	6.8	0.4	0.3	Water is slightly cloudy with a mild odor. Fish are less active and not feeding as well as before.	Increased aeration and reduced feeding.

Table 1. Example of a water quality monitoring log.

Maintaining a record of water quality checks is essential, as it allows you to identify trends and patterns in the water quality data. You can then use this information to optimize your feeding schedule and make necessary adjustments to environmental factors such as water flow, aeration and temperature. These activities can help prevent disease outbreaks and improve fish growth rates and ultimately lead to a more profitable and sustainable farming operation.

Having a clearly defined water quality monitoring process, including recordkeeping, has left Mary feeling thrilled. Now, she can train her employee efficiently on the new standards and delegate some of her tasks, freeing up her time.

Having clear and concise SOPs for each task and process on the farm is one of the most crucial standards to implement. This ensures consistency and quality in the work performed. Additionally, it is important to establish clear performance metrics, such as fish growth rate, feed conversion ratio and water quality, to measure progress and identify opportunities for improvement. Finally, it is also essential to have a system for continuous improvement to make sure everyone is always looking for ways to improve processes and optimize performance.

Standards are a secret weapon. Creating and using standards on a fish farm is vital as this will

- promote consistency in work quality and output by ensuring that all tasks are performed the same way every time;
- help identify areas of inefficiency, allowing for improvements that can increase productivity and profitability;
- provide guidelines that ensure products or services meet specific quality standards, which can help build a strong reputation for the farm and its products;
- help establish safe working conditions and practices, reducing the risk of employee accidents or injuries;
- ensure that the farm complies with regulations and laws, reducing the risk of legal or regulatory issues.

Creating and implementing standards is vital for a fish farm's long-term prosperity and sustainability, which can help enhance profitability and success. So, consider the power of developing standards for your farm operations, as this is crucial to ensure consistency, efficiency, quality control, safety and compliance. So why not dive in and start creating as many standards as possible? Trust us, your farm will benefit from it in more ways than you can imagine.

10. Lock it down

Wow, you have made incredible progress and achieved so much, from identifying your goals to implementing and standardizing your lean management improvements. That is no small feat!

Transforming a small fish farm by implementing lean management principles is a brilliant move that can substantially improve productivity and efficiency. However, implementing changes is just the beginning, and it's not enough to sit back and hope for the best. It's paramount to measure and monitor these changes to guarantee three things:

1. The employees are adhering to the new protocols.
2. The lean management improvements are yielding the anticipated results.
3. Awareness is created for further improvements to optimize the production process for maximum efficiency and profitability.

By measuring and monitoring changes, you can translate your efforts into measurable success and pave the way for further growth and development. These activities are crucial to ensure your improvements are sustainable and effective in the long term. The effort is worth it!

Let's take the plunge into the next phase of tracking and evaluating your progress. Monitoring and measuring are vital to ensure that the newly implemented processes are executed effectively and produce the desired outcomes. With that said, let's forge ahead to step 6 of the RIE tool.

10.1. RIE Step 6

Monitor and measure: Monitor the new process continuously to measure its effectiveness and identify any areas that require further improvement.

First, let's begin by focusing on monitoring the improvements. You need to make sure those positive changes you've made on your farm last for the long haul. It's crucial to ensure the sustainability of the improvements you've implemented, and it is equally essential to ensure that all your team's work is not done in vain. We understand that

change can be tough, but doing regular audits for processes can make adapting to new ways of doing things much easier. By developing an audit checklist that combines a standard with a visual tool, you can effectively monitor your farm's critical processes and ensure they are carried out correctly. These audits typically take the form of a checklist or questionnaire, and they help you assess whether your farm is adhering to the necessary procedures. The monitoring tool will make the audit process accurate, efficient and systematic, allowing you to sustain the recent changes and continue improving your farm's operations. It's a straightforward and effective approach that will help you achieve long-term success.

Mary's farm

Mary is determined to sustain her farm's lean management improvements and is keen to have her team create and implement monitoring audits. The team has used this approach quickly to develop farm checklists that ensure the employee adheres to the new standards designed for both the fish feeding and water quality monitoring processes. The objective here is to ensure that the fish feeding process is followed and that fish are fed regularly and appropriately.

By conducting an audit and monitoring the fish feeding process, you are ensuring the consistency of the process and its outcomes. For example, the audit verifies whether employees have followed the feeding schedule correctly, given the fish the appropriate amount of feed, modified feeding as needed, and documented the feeding records accurately. Audits should be done as frequently as weekly, biweekly or monthly based on the peculiarity of the farm. The objective here is to make sure that employees are following the water quality process and maintaining the fishpond at a level that is conducive to the growth and health of the fish.

On Mary's farm, the objective of the auditing checklist is to observe the water quality monitoring process closely and check that it is being followed correctly. This will enable a better understanding of whether employees are maintaining the water quality in the fishpond at a level conducive to the growth and health of the fish.

Auditing checklists are perfect for new lean management processes because they provide a structured and systematic approach to assess the implementation and effectiveness of the new process. By using an auditing checklist, the team can cover all the essential aspects of the process during their monitoring step. The checklist can also serve as a reminder of the critical points that need to be addressed during the audit. Additionally, auditing checklists can help identify gaps or areas that need improvement, which can be addressed through continuous improvement efforts. Are you convinced? Take some time to determine which processes are

critical to monitor and create documents like the ones in Table 2 and Table 3. Auditing checklists are a valuable tool in ensuring that new lean management processes are implemented effectively and stand the test of time.

In summary, monitoring improvements is essential for ensuring the sustainability and effectiveness of the lean management changes made in a process. By creating an audit checklist, you can monitor critical processes and carry them out correctly, which helps sustain improvements and optimize operations for maximum efficiency and profitability.

Auditing questions	Yes	No
Is the feeding schedule being followed?	X	
Is the amount of feed appropriate for the fish?	X	
Is feeding adjusted as necessary based on fish behavior and environmental factors?	X	
Are feeding records accurately and consistently documented?	X	
Are relevant remarks being consistently documented?	X	

Table 2. Audit form for the fish feeding process.

Audit criteria	Yes	No	N/A	Observations	Action taken
1. Water temperature consistently within range (24°C–30°C)					
2. DO level (at least 5 ppm)					
3. pH level (6.5–7.5)					
4. Ammonia level (less than 0.5 ppm)					
5. Nitrite level (less than 0.2 ppm)					
5. Water cleanliness (color, odor or debris)					
6. Observations and actions documented accurately					

Compliance questions
7. Meeting process standards
8. Improvements needed

Table 3. Audit form for the water quality monitoring process.

11. Count the money

Congratulations, you are well on your way to success. Your new processes are implemented, and you are auditing to ensure the standards are followed. That's fantastic! Now, it is officially time to evaluate the fruits of your team's labor by measuring and analyzing the results.

11.1. RIE Step 6 (Continued)

Monitor and measure: Continuously monitor the new process to measure its effectiveness and identify any areas that require further improvement.

11.1.1. Measuring improvements

To measure activities on a fish farm well, you must collect and analyze data regularly. There are six steps to make sure you have a sound system for measuring:

1. **Define key performance indicators (KPIs):** Identify and define the KPIs relevant to your fishpond operations, especially relating to the identified source of production waste, such as feed used, survival rate, growth rate and harvest size. These KPIs will help you measure the effectiveness of your improvements.
2. **Collect data:** Collect data regularly on the identified KPIs. Make sure the data is accurate and reliable.
3. **Analyze data:** Analyze the data to evaluate the performance of your fishpond operations. Compare the current data to the baseline data before implementing the improvements to assess the impact of the changes.
4. **Identify opportunities for improvement:** Based on the data analysis, identify areas for further improvements. This could involve adjusting the current processes or procedures to optimize efficiency or modifying the improvements that you have implemented.
5. **Implement further improvements:** Once you have identified additional opportunities for improvement, implement changes and monitor their effectiveness by collecting and analyzing both before and after data.

6. **Communicate results:** Inform all stakeholders of the results of the data analysis and improvement efforts to create awareness and encourage further improvements.

By regularly monitoring and measuring the KPIs, you can track the effectiveness of improvements and make data-driven decisions to optimize the production process. The farm can track progress and identify any issues or bottlenecks hindering the effectiveness of the changes. You can then use this information to make data-driven decisions to optimize the production process further to maximize efficiency and profitability. Additionally, measuring and monitoring the changes can help the farm identify wasted resources or opportunities to reduce costs. This can lead to significant savings in both time and money, further contributing to your farm's overall success.

On Mary's farm, the RIE team was overjoyed to learn about the impacts they achieved through the changes they implemented on her farm. Let's see how they did.

11.1.2. Feed improvements

In the world of small-scale fish farming, every dollar counts. That's why making changes to feed costs can have a massive impact on profitability.

Mary, a small-scale fish farmer, has realized that reducing the amount of feed given to her fish while ensuring they still receive the nutrients they need to grow can lead to huge savings on feed costs. After some research and discussion with her RIE team, Mary decides to reduce the amount of feed from 8 to 6 percent of fish weight. This change leads to a 25 percent reduction in total feed use, resulting in a significant cost-saving. Mary also opts for local, nutritious floating feed, which costs USD 1.52/kg compared to her previous feed cost of USD 1.25/kg. Although the initial cost is higher, the team believes that the extra cost is justified because the floating feed gives them the ability to see when the fish are satiated to avoid wasting feed.

The results are in! Over 6 months, the improved feed quality and reduced feeding protocol has resulted in faster fish growth and an 80 percent reduction in mortality rates, from 25 to 5 percent. In addition, Mary has seen a 33 percent increase in yield, from 3.6 to 4.8 t. This is a direct result of improved water quality and more nutritious feed.

The revenue impact of these changes over 6 months is remarkable. Mary's original revenue was USD 8604 from 3.6 t of fish at USD 2.39/kg. After the changes, she has produced 4.8 t of fish, generating USD 11,472 in revenue. Additionally, by analyzing her profits, Mary saw that she had a loss of USD 396 (-4.4 percent) on her feed investment before the changes. After the changes, Mary has turned that into a USD 3264 (39.77 percent) return on her feed investment.

In conclusion, Mary's decision to reduce her feed costs and improve feed quality has impacted her profitability as a fish farmer significantly. With these changes, she has increased her revenue and reduced losses, demonstrating the importance of optimizing feed costs in small-scale fish farming.

11.1.3. Fish feeding process improvements

Dramatically improving the feed process can impact fish farming operations significantly, and Mary's farm nailed it! With no more time spent sifting through the feed to remove dust and no excessive movement to get the feed to the ponds, Mary has drastically reduced the time spent on feeding. She has shortened the distance traveled 80 percent, from 100 m down to just 20 m, which has decreased the amount of time feeding per pond 66.7 percent, from a whopping 45 minutes to just 15. For two ponds with two feeding times, the time savings is 1 hour per day or 180 hours every 6 months. This is a huge improvement in efficiency, allowing Mary and her employee to focus on other value-added tasks, leading to a more productive and profitable operation. With such innovative changes in the feed process, it's clear that Mary is committed to finding ways to improve her farm's overall performance.

11.1.4. Water quality and water pump improvements

Mary's water quality improvements have led to a significant reduction in pump use. Previously, two pumps were operated for 16 hours, with

each running for 8 hours. However, with the improvements, Mary now utilizes only one pump, which serves both ponds and operates for 4 hours. This amounts to a remarkable 75 percent decrease in pump use. Mary has also been able to reduce the cost of fuel significantly, from 20 L per day at a rate of USD 0.56/L, which amounts to USD 11.20 per day or USD 2016 over 6 months, to just 5 L per day at the same rate, which now amounts to USD 2.80 per day or USD 504 over 6 months. As a result, the total savings realized from the reduced pump use and fuel costs amount to USD 1512 over 6 months.

Mary and her team have achieved these reductions by improving the water quality in her fishponds, which has reduced the amount of time needed for pumping. With just one pump running both ponds for 4 hours, the water quality is maintained at the appropriate level, and the fish are thriving. In addition, reducing pump use and fuel costs have helped lower greenhouse gas emissions, which is beneficial to the environment. The farm also benefits economically, as the savings increase profits. These improvements show that small changes can have a big impact, and it's worth investing in maintaining good water quality in fishponds.

11.1.5. Fish mortality improvements

Improving fish survival is essential to the success of any fish farming operation. Through a combination of water quality improvements and providing a higher level of nutrition, Mary has significantly reduced the mortality rate of her fish. Previously, 25 percent of her fish died, dramatically reducing revenue. However, by introducing a new, nutritious feed and improving the water quality, the mortality rate has dropped to just 5 percent. This 80 percent improvement in fish survival has tremendously impacted Mary's bottom line, with revenue increasing from USD 8604 to 11,472, representing a 33.33 percent rise in income.

By focusing on these critical areas, all fish farmers can see significant improvements in their business and, ultimately, achieve greater success in their operations.

The numbers reflected on Mary's farm represent some of the improvements achieved by implementing lean management in more than 200 small-scale fish farms.

11.2. Beyond the numbers

The lean management activities on Mary's farm have reaped big rewards: improved feeding efficiency, lower fish mortality, reduced time wasted in both motion and transportation, smaller environmental footprint, lower stress on labor, improved profit, shortened harvest cycle and increased farm expansion opportunities. Mary's decision to reduce her feed costs and improve feed quality have increased her revenue and profit, boosted efficiency, benefitted the environment, improved fish survival and resulted in innovative changes that have led to positive outcomes. Mary and her team's commitment to finding ways to improve her farm's overall performance demonstrate their willingness to innovate and make changes that lead to tremendous results, which is essential for the long-term success of any farming operation.

Defining KPIs, collecting data, analyzing data, identifying opportunities for improvement, implementing further improvements and communicating results are the steps involved in measuring improvements and results. Regularly monitoring and measuring KPIs can help track the effectiveness of improvements, optimize production processes and identify wasted resources or opportunities to reduce costs. Overall, this phase is crucial for long-term success and continuous improvement.

Measuring and monitoring a fish farm can significantly improve production efficiency, profitability and cost savings. By defining measurements, collecting and analyzing data, implementing further improvements and communicating results, farmers can track progress, optimize production processes and make data-driven decisions.

Mary's farm is an excellent example of how reducing feed costs and improving feed quality, water quality and the fish feeding process optimizes a farm's efficiency and significantly impacts profitability in small-scale fish farming. With innovative changes in the feed process and water quality, Mary's farm has increased yield, reduced losses and improved overall performance. By implementing these improvements, fish farmers can not only maximize their profitability but also make a positive impact on the environment.

Step 6 is complete! There is just one more step to go in the RIE. And it's fun! Here's a quick reminder of all the work you have done so far:

RIE Step 1: (Complete)

Define the problem or opportunity for improvement: Clearly define the issue or process that needs improvement and establish measurable goals for success.

RIE Step 2: (Complete)

Assemble a team: Create a cross-functional team of individuals with diverse skills and perspectives who can help identify the root cause of the problem and develop effective solutions.

RIE Step 3: (Complete)

Analyze the current state of the target process: Collect data and analyze the current process to identify areas of waste, inefficiencies, and opportunities for improvement.

RIE Step 4: (Complete)

Develop and test potential solutions: Brainstorm and evaluate potential solutions, and then test them to see if they address the root cause of the problem.

RIE Step 5: (Complete)

Implement and standardize: Once you have identified and tested a solution, implement it and create standard work procedures to ensure consistency and sustainability.

RIE Step 6: (Complete)

Monitor and measure: Monitor the new process continuously to measure its effectiveness and identify any areas that require further improvement.

12. Time to celebrate

Yes, indeed! All the hard work has paid off, and it is time to do something that lets everyone know how much you appreciate their involvement in making improvements and taking your farm to the next level.

12.1. RIE Step 7

Celebrate success: Celebrate and recognize your team's hard work and success in achieving the goals of the RIE. This helps build momentum and support for further efforts at improvement.

12.1.1. Mary's farm

Mary and her RIE team are celebrating with a celebratory potluck meal. They are enjoying taking a moment to honor their work and the results they have achieved. The atmosphere is filled with pride, and they have suggested many additional ideas for future team events.

Here are some ideas for you to celebrate your success (you can also come up with your own):

- **Throw a party:** Celebrate the team's success with a party or gathering. This could be a potluck lunch, a barbecue or even a dinner at a restaurant.
- **Recognition awards:** Present the team with awards or certificates to recognize their hard work and success. This could be done at a team meeting or in front of a group.
- **Bonuses:** If possible, provide bonuses or other incentives for the team's success. This could be in the form of monetary rewards or extra time off.
- **Publicize your success:** Share the team's success with others in the organization or with stakeholders. This could be done through an email, a newsletter or a press release.
- **Team outing:** Take the team on a fun outing or activity to celebrate their success. This could be a team-building exercise, a trip to a local attraction or a day off to relax and recharge.

The possibilities are endless. So, please make an effort to celebrate your team's success and inspire them to achieve even greater heights.

In summary, measuring improvements on a fish farm is crucial to optimize production processes, reduce costs and increase profitability. By following the steps of defining KPIs, collecting and analyzing data, identifying opportunities for improvement, implementing changes and communicating results, farmers can track progress and make data-driven decisions. The case of Mary's farm shows the significant impacts of making changes to feed costs, improving feed quality and the feeding process, as well as improvements to water quality and water pumps. These changes have resulted in a remarkable increase in revenue and profitability, demonstrating the importance of constantly seeking ways to improve and optimize farm operations.

Celebrating success is also an essential step toward achieving continuous improvement. It not only recognizes the team's hard work but also helps build momentum and support for further efforts at improvement. There are many ways to celebrate success; the key is to choose a celebration that suits your team and organization and inspires them to achieve even greater success in the future. Remember, a little celebration can go a long way in boosting team morale and encouraging them to strive for excellence.

13. Conclusion

This guide on lean management has offered you a simple and effective solution to address high costs and inefficiencies on a small-scale fish farm. Mary's story proves that implementing lean management principles can dramatically impact your farm's efficiency and bottom line.

Mary started by defining her farm's high-level goals to help improve profits and then delved into learning the philosophy and tools behind lean management. With a team in place, she followed the steps of the RIE and made significant improvements.

The results after 6 months of implementation were staggering. Mary lowered her feed costs 9 percent, thanks to a 25 percent reduction in feed use and a switch to higher-quality floating feed. She also decreased her fuel use a whopping 75 percent, resulting in a USD 1512 cost-reduction. She also used her employees more efficiently through cross-training and problem-solving, freeing time for her to do other value-added work.

In fish feeding alone, Mary managed to free up 180 hours. She also dropped mortality rates from 25 to just 5 percent, while increasing both fish yield and revenue. Perhaps most impressively, Mary's revenue grew from USD 8604 to USD 11,472.

With these kinds of results, it's easy to see why lean management is the key to transforming your small-scale fish farm into a lean, mean, profit-making machine.

By following the roadmap provided in this guide and learning about the fundamental principles and tools of lean management, you too can take your small-scale fish farm to the next level.

All right, now it's time for you to take the plunge and level up your small-scale fish farm. You've got the roadmap and the tools in your arsenal. It's time to make a splash and start putting lean management into action. Don't be a fish out of water—dive right in and see the improvements in your operations and revenue. There's no better time than the present to take action. You've got what it takes to make it happen!

For additional resources, please check out our website at www.collaborative-impact.com



About WorldFish

WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving aquatic food systems, including fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world.

The WorldFish headquarters is in Penang, Malaysia, with regional offices across Africa, Asia and the Pacific. The organization is a member of CGIAR, the world's largest research partnership for a food secure future dedicated to reducing poverty, enhancing food and nutrition security and improving natural resources.

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