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DESIGN APPLICATION AND ITS ECONOMIC ANALYSIS OF QUICK TEMPE TECHNOLOGY IN PAMULANG

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Abstract

Ipeh Tempe House in Pamulang was unable to fulfill their demand for more tempe production due to their limitation to expand the production using their own method. Quick Tempe technology is a Tempe production method with less production time than the common production method. Implementation of this method could increase production capacity without further infrastructure investment. Prior the implementation, the quick Tempe technology was adjusted with the current production method in Ipeh Tempe House. The scheduling models of GDL tempe production method in Ipeh tempe house were designed to increase the production capacity of Ipeh tempe house, and the economic analysis was also performed to see whether the schedules suggested was feasible to do in real life, by calculating the profits generated by the schedules, and all of them were more profitable than normal method. To conclude, the procedure can create more batches, while giving more profit, but validation for the procedure and calculation is still needed to be done, other thing such as back slopping sensory test is also need to be done.

Keywords : *Tempe, Quick Tempe Method, Economical calculation, Design Application*

INTRODUCTION

Indonesia has the largest tempeh production in the world it can produce up to 24 million tons per year and the profit from the industry can reach up to Rp. 37 trillion per year [1].

The characteristic of small home industry that produced tempeh usually lives on highly dense population just like Kampung Kedaung in Pamulang is also one of the communities of tempeh artisan that live in a dense population.

Ipeh Tempe house is one of the Artisan that live In Kampung Kedaung, that have a high demand of tempeh and they need to increase their production capacity to full fill the demand. Increase production capacity usually involving production area

expansion, however both are hardly aquired due to dense population

A new tempeh production method by using GDL (Glucono Delta-Lactone) that was developed to able to shorten the production time, so it can create a more productive time management for the workers [2]. GDL Production method can be used in Ipeh Tempeh House to increase their production capacity and full fill the demand.

Although quick tempeh method has a quicker production time compares to normal method, in order to increase the production capacity, a new system schedule that are capable to produce several batches of tempeh production on one day, the schedule will be designed with the characteristic of Ipeh Tempeh House in mind, which are time for selling, machine capacity and equipment, and the workforce.

The experiment will start with gathering information about Ipeh Tempeh House's characteristic which are time for selling, machine capacity and equipment, and the workforce, and the data obtained from information gathering will be used to adjust the GDL method into the Ipeh Tempeh house, hence creating a GDL method for Ipeh Tempeh House, the adjustments were the Starter amount, GDL addition method, and Backslopping Potential. When the adjustments were made, the schedule based on this was created to boost the production capacity without adding more equipment into the production room this new schedule will be based on the GDL production that was previously created for this step, and the suggested schedules were tested with. economic analysis for each production method that was suggested to see whether they are economically feasible to do in real production.

METHOD

The first stage of the experiment was designing a quick tempeh method design with the characteristic of Ipeh Tempeh house.

Production details, daily schedule of the production and the economical details of the production house was the characteristic on the Ipeh Tempeh House, and was obtained by interviewing the owner and visiting the place.

After the characteristic and production schedule was obtained, the GDL method will be implemented The second stage focuses on the scheduling of the new method so that the Tempeh house can produce tempeh for more than one time to increase the production without investing equipment, and the productivity was calculated and compared for one-month production. There are several models that will be compared, model 0, the old method,

The third and the final stage was to show the economical calculation based on the schedules that was suggested by the second stage, to prove that the schedules suggested can increase the profit without investing more money.

RESULT AND DISCUSSION

1. Current Situation of Tempeh Production in Ipeh Tempeh House

From the result of the observation and interview, the technology that the Ipeh Tempeh House have was rather modern, due to the addition of de-hulling machine, the steel tub had a build in faucet for water to be flushed after usage. The production condition can be seen on figure 1.

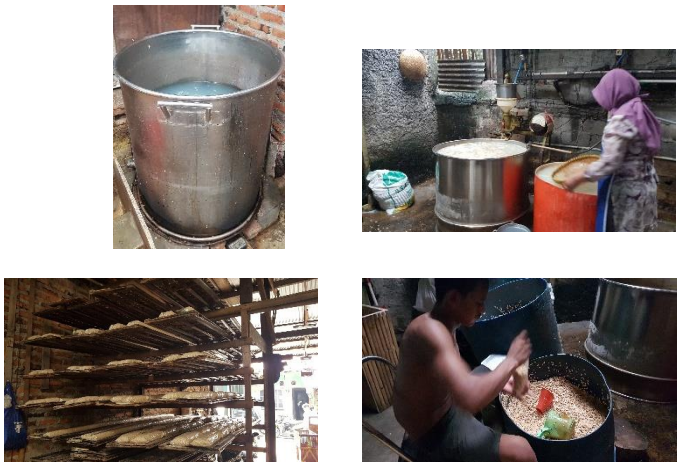

Figure 1. Boiling Tub , Dehulling Process, Yeast Mixing, and Incubation Process

The production method on the Ipeh Tempeh house was described with the flowchart on the figure 2, there were several steps that defined the Ipeh Tempeh House characteristics for the tempeh production, specifically on soaking, and boiling process.

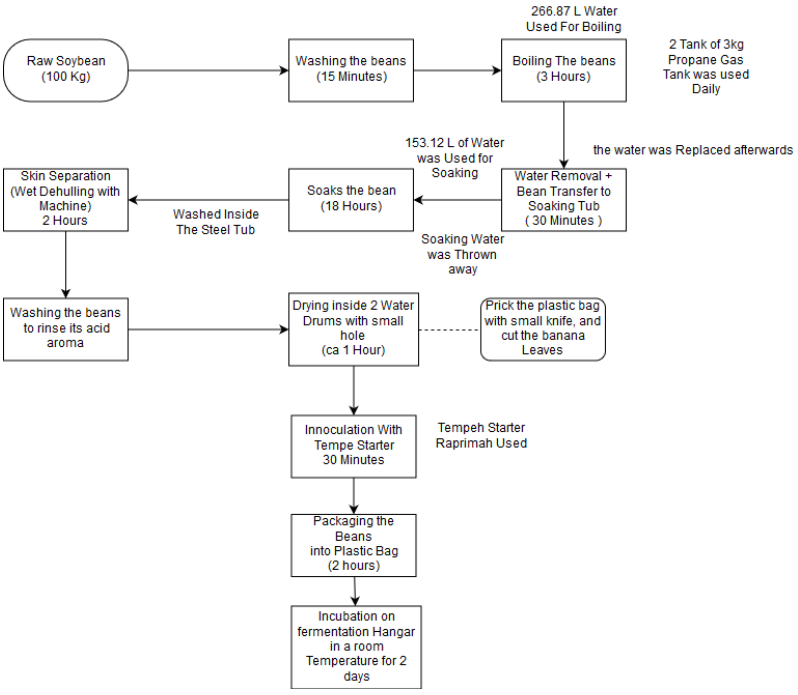

Figure 2. the Production Flow of Ipeh Tempeh House

The schedule was obtained from the interview and observations, the schedule from table 1 was based on the daily activity of the worker on Ipeh Tempeh House. The table depicts Tempeh House's worker who always came

at 10 AM and leave at 4 PM. The important characteristic of the production schedule was the time of selling the product and the soaking time that cannot be moved due to the selling time was always at 4:30 AM on the morning. Table 4 depicted the details of the tempeh production. It took 4 days to create one batch of tempeh daily. Meaning that there will be 27 batches of tempeh production in total. The production starts at 10 in the morning by cleaned and dehulled the beans that was previously soaked overnight and ends at 4 PM with packaging the tempeh from the same batch and soaked the next batch of beans for tomorrow.

Table 1. Daily Production Schedule

<table>
<tr><th rowspan="2">TIME</th><th colspan="2">DAILY ROUTINE (1 Batch Per Day)</th></tr>
<tr><th>Previous Batch</th><th>New Batch</th></tr>
<tr><td>01:00</td><td>Soaking Beans</td><td rowspan="3">Incubation</td></tr>
<tr><td>02:00</td><td>Soaking Beans</td></tr>
<tr><td>03:00</td><td>Soaking Beans</td></tr>
<tr><td>04:00</td><td>Soaking Beans</td><td>Sell the Product</td></tr>
<tr><td>05:00</td><td>Soaking Beans</td><td></td></tr>
<tr><td>06:00</td><td>Soaking Beans</td><td></td></tr>
<tr><td>07:00</td><td>Soaking Beans</td><td></td></tr>
<tr><td>08:00</td><td>Soaking Beans</td><td></td></tr>
<tr><td>09:00</td><td>Soaking Beans</td><td></td></tr>
<tr><td>10:00</td><td>Dehulling</td><td></td></tr>
<tr><td>11:00</td><td>Washing + Separation</td><td></td></tr>
<tr><td>12:00</td><td>Drying</td><td></td></tr>
<tr><td>13:00</td><td>Mixing With Tempe Starter</td><td>Washing the beans</td></tr>
<tr><td>14:00</td><td rowspan="2">Packing the Beans</td><td rowspan="2">Boiling Beans</td></tr>
<tr><td>15:00</td></tr>
<tr><td>16:00</td><td rowspan="9">Incubation</td><td>Soaking Beans</td></tr>
<tr><td>17:00</td><td>Soaking Beans</td></tr>
<tr><td>18:00</td><td>Soaking Beans</td></tr>
<tr><td>19:00</td><td>Soaking Beans</td></tr>
<tr><td>20:00</td><td>Soaking Beans</td></tr>
<tr><td>21:00</td><td>Soaking Beans</td></tr>
<tr><td>22:00</td><td>Soaking Beans</td></tr>
<tr><td>23:00</td><td>Soaking Beans</td></tr>
<tr><td>00:00</td><td>Soaking Beans</td></tr>
</table>

Table 1 details the daily production schedule based on Ipeh Tempeh House on Pamulang, Worker start the day at 10 AM as indicated by the red mark at the table 1, and finish at around 4 PM. Soaking time as seen on table 1 was a long process, soaking started at noon and continue until the next day when the worker started working again at 10 AM, and the time were not flexible, due to the product selling time that cannot be changed due to the demand. Regular/normal tempeh production took 4 days for one batch of production. Total of 434 pieces of tempeh was

produced daily at the Ipeh Tempeh House, to sum for one month, 13020 pieces of tempeh that were produced for 30 days of production.

The production flow then was reformed to fit with the GDL production method, with less washing and soaking time, but using the same equipment, only with an addition of GDL during soaking, to cut down production time.

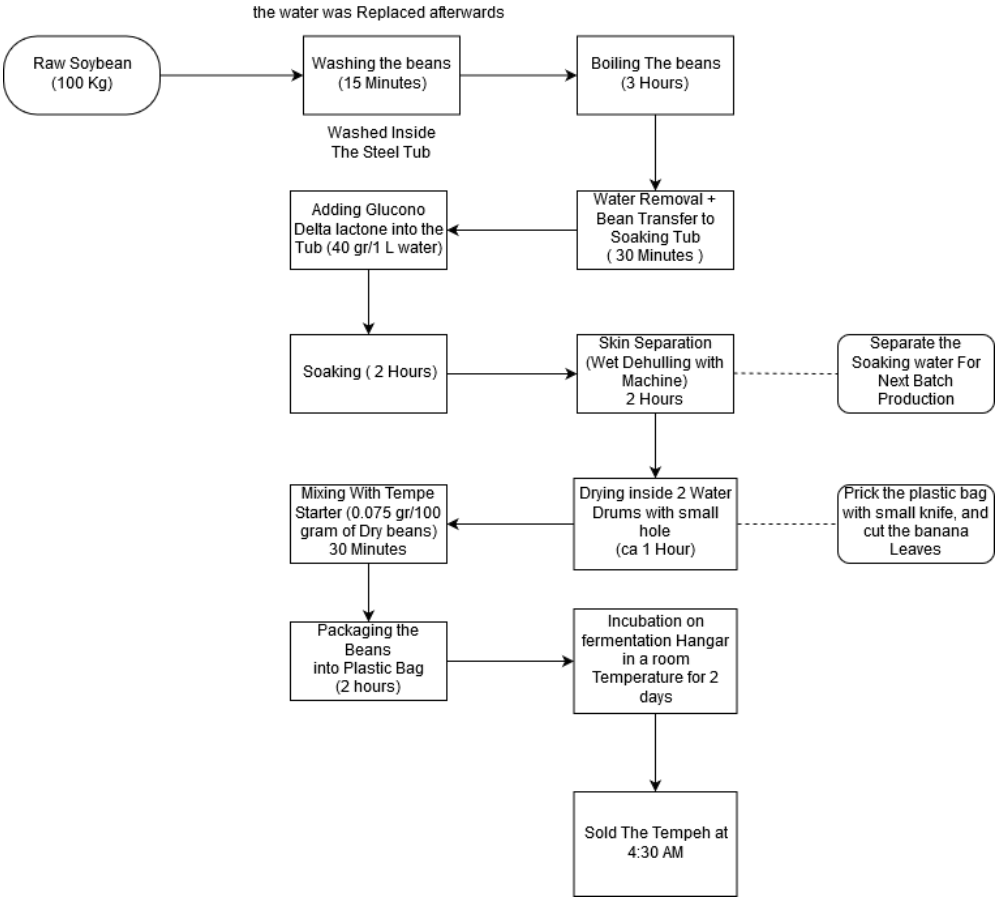

Figure 3 New GDL Designed Procedure Flowchart

the procedure that were depicted on the figure 3 was similar with the previous method, save for a few details, soaking process had mix the GDL within the water before the beans were added into the tub, and the soaking process duration was shortened from 18 hours into 2 hours.

This production flowchart will be the foundation for the next stage, which are designing a production schedule in Ipeh Tempeh House.

2. Design of GDL Chemical Adition Application at Ipeh Tempeh House

The production schedule was created based on what the employee's daily routine, by the interview that was done earlier. The data was manifested in a table form, where the schedule was written and compared. For this stage, several assumptions must be made to create an equal testing ground., assume that there are 30 days in one month instead of 31

days, no production was made before the first day on the schedule, and there is also no production will be made if there are step that is need to be done past day 30. There will be 3 variant of schedule model that will be explained.

Model 1 (2 Batch GDLAcidification Method)

Model 1 composed of two GDL acidification method that was previously defined on stage 1 with several repetition to increase the production capacity within one day. the regular method cannot improve the productivity due to the tightness of the normal schedule that Ipeh Tempeh House had, the soaking was taking 18 hours as opposed the GDL soaking method, which was only 2 hours of soaking, the necessary equipment next then will be used again.

The potential schedule for the new production method, the first one being the new GDL method that was done twice a day, was possible due to time gap between each procedure, so the equipment such as the boiler, the soaking tank can be used twice each day.

GDL production schedule need 1 day less to complete the production, can create more batches than the normal production schedule, and the new GDL production can be done two times a day, to increase the productivity since the worker started earlier on the day which at 7 AM, and finish at 7 PM, which were longer compared to the normal method.

Table 2 detailed the model schedule that the worker will as the daily basis, with two schedules per day, the first batch began at 7 AM and the second batch begun 10 AM, when the first batch undergoes soaking. The rest was similar with the last procedure until it was ready to be sold.

Table 2. Model 1 (2 GDL method Schedule)

DAYS	TIME	Batch 1	Batch 2	Batch 3	Batch 4
DAY 1	04:00				
	07:00	Washing + Boiling Beans			
	08:00				
	09:00				
	10:00	Soaking the beans (2 hours)	Washing + Boiling Beans		
	11:00				
	12:00	Dehulling + Separation			
	13:00	Drying	Soaking the beans (2 hours)		
	14:00	Mixing with tempeh Starter			
	15:00	Packing The Beans	Dehulling + Separation		
	16:00	Incubation	Drying		
	17:00	Incubation	Mixing with tempeh Starter		
	18:00	Incubation	Packing The Beans		
	19:00	Incubation	Incubation		
	20:00	Incubation	Incubation		
	21:00	Incubation	Incubation		
	22:00	Incubation	Incubation		
	23:00	Incubation	Incubation		
DAY 2	00:00	Incubation	Incubation		
	01:00	Incubation	Incubation		
	02:00	Incubation	Incubation		
	03:00	Incubation	Incubation		
	04:00	Incubation	Incubation		
	05:00	Incubation	Incubation		
	06:00	Incubation	Incubation		
	07:00	Incubation	Incubation	Washing + Boiling Beans	
	08:00				
	09:00				
	10:00			Soaking the beans (2 hours)	Washing + Boiling Beans
	11:00				
	12:00			Dehulling + Separation	
	13:00			Drying	Soaking the beans (2 hours)
	14:00			Mixing with tempeh Starter	
	15:00			Packing The Beans	Dehulling + Separation
	16:00			Incubation	Drying
	17:00	Incubation	Incubation	Incubation	Mixing with tempeh Starter
	18:00	Incubation	Incubation	Incubation	Packing The Beans
	19:00	Incubation	Incubation	Incubation	Incubation
	20:00	Incubation	Incubation	Incubation	Incubation
	21:00	Incubation	Incubation	Incubation	Incubation
	22:00	Incubation	Incubation	Incubation	Incubation
	23:00	Incubation	Incubation	Incubation	Incubation
DAY 3	00:00	Incubation	Incubation	Incubation	Incubation
	01:00	Incubation	Incubation	Incubation	Incubation
	02:00	Incubation	Incubation	Incubation	Incubation
	03:00	Incubation	Incubation	Incubation	Incubation
	04:00	Sell the Product	Sell the Product	Incubation	Incubation
	05:00			Incubation	Incubation
	06:00			Incubation	Incubation
	07:00			Incubation	Incubation
	08:00			Incubation	Incubation
	09:00			Incubation	Incubation
	10:00			Incubation	Incubation
	11:00				
	12:00				
	13:00				
	14:00				
	15:00				
	16:00				
	17:00				
	18:00				
	19:00				
	20:00			Incubation	Incubation
	21:00			Incubation	Incubation
	22:00			Incubation	Incubation
	23:00			Incubation	Incubation
DAY 4	00:00			Incubation	Incubation
	01:00			Incubation	Incubation
	02:00			Incubation	Incubation
	03:00			Incubation	Incubation
	04:00			Sell the Product	Sell the Product

Within the first month, the production had increased since there were two batches for 1 day as opposed to one batch per day, naturally the productivity was also increased since there are many more that worker need to be done. The schedule changes the worker working schedule from 10 AM – 4 PM to 7 AM – 7 PM, the change happened due to the selling time is still at 4:30 AM, the new method had to adjust the time for incubation and the tempeh condition when it was delivered, and the production was also altered to prevent the and no downtime on the equipment since it was being used multiple time during the day, and finally, worker's salary was also adjusted on the later stage to compensate the extra worktime for the new model.

There were 60 batches of production as opposed to the normal schedule, there are pieces of tempeh that can be sold for 30 days (1 month) of the implementation of table 2.

Model 2 (2 GDL Method + 1 Natural Method)

Model 2, combined both of the normal procedure with model 1 procedure, hence the production becomes three batches per day, which was possible to do. To leave the soaking for normal production elsewhere without disrupt the flow of the GDL production, just with additional tub that Ipeh Tempeh House had.

Due to combining the previous method, even more tempeh can be sold per day and this schedule

can be applied if the demand is super high compare to the previous schedule, since it can produce up to 3 batches per day. On first month of the production, it can create up to 39060 pieces of tempeh for 30 days (1 month), which was really huge when compares to the original procedure. And the detail of the procedure will be presented on table 3.

Table 3. Model 2 (2 GDL Schedule + 1 natural acidification Schedule)

TIME	DAILY PRODUCTION			
	GDL BATCH	**GDL BATCH 2**	**Normal Batch 1**	**Normal Batch 2**
00:00			Soaking Beans	Incubation
01:00			Soaking Beans	
02:00			Soaking Beans	
03:00			Soaking Beans	
04:00	Sell the Product	Sell the Product	Soaking Beans	Sell the Product
05:00			Soaking Beans	
06:00			Soaking Beans	
07:00	Washing + Boiling Beans		Soaking Beans	
08:00			Soaking Beans	
09:00			Soaking Beans	
10:00	Soaking the beans (2 hours)	Washing + Boiling Beans	Dehulling	
11:00			Washing + Separation	
12:00	Dehulling + Separation		Drying	
13:00	Drying	Soaking the beans (2 hours)	Mixing With Tempe Starter	Washing the beans
14:00	Mixing with tempeh Starter		Packing the Beans	Boiling Beans
15:00	Packing The Beans	Dehulling + Separation		
16:00	Incubation	Drying	Incubation	Soaking Beans
17:00		Mixing with tempeh Starter		Soaking Beans
18:00		Packing The Beans		Soaking Beans
19:00		Incubation		Soaking Beans
20:00				Soaking Beans
21:00				Soaking Beans
22:00				Soaking Beans
23:00				Soaking Beans
00:00				Soaking Beans

Table 3 displayed the production schedule of model 2. Similar to model 1, the work started at 07 AM, and finish at 7 PM, with 3 batches of production to be done per day, started with washing and boiling for GDL production batch, at 10 AM, the washing for the next batch of GDL production started until all the procedure were finished at 7 AM similar to the model 1 and the difference at model 2 was the additional batch from model 0. The flow of the GDL batches production was not interrupted within each other since there was no clashing of usage of equipment, to eased the worker, and production increased.

The normal production batch started at 1 PM on the afternoon, the rest of the normal production will be continued the next day during the soaking. Every day, tempeh created will be sold at 4 AM daily. The important soaking process for normal procedure was around 1 day, and the timing between dehulling for normal method and soaking method of GDL batch 1 was tight at 10 AM, the beans must have been removed and cleaned in small period of time, so that the schedule did not crashed with each other.

Another important part was when the methods started to conjunction with one another, the timing of the production for each batch had to be precise and punctual for the worker to be finished at 7 PM. To mitigate the issues, additional worker can be hired in order to save time.

The model schedule can be used if the demand was big and model 1 cannot handle the production capacity that was demanded by the consumer.

Model 3 (1 GDL Method + 1 Natural Method)

Another schedule model was suggested, the new model was based on modification of Model 2 of 3 batches of tempeh production schedule by removed one GDL schedule from the model, resulted on a more manageable schedule, with less worktime for the worker, lessening the chance of unnecessary stress caused by overworking, the modified model was called model 3, and the schedule can be seen on the table 4.

Table 4 Model 3 Schedule (1 Normal Method and Sync Method)

TIME	DAILY PRODUCTION		
	GDL BATCH	Normal Batch 1	Normal Batch 2
00:00		Soaking Beans	Incubation
01:00		Soaking Beans	
02:00		Soaking Beans	
03:00		Soaking Beans	
04:00	Sell the Product	Soaking Beans	Sell the Product
05:00		Soaking Beans	
06:00		Soaking Beans	
07:00	Washing + Boiling Beans	Soaking Beans	
08:00		Soaking Beans	
09:00		Soaking Beans	
10:00	Soaking the beans (2 hours)	Dehulling	
11:00		Washing + Separation	
12:00	Dehulling + Separation	Drying	
13:00	Drying	Mixing With Tempe Starter	Washing the beans
14:00	Mixing with tempeh Starter	Packing the Beans	Boiling Beans
15:00	Packing The Beans		
16:00	Incubation	Incubation	Soaking Beans
17:00			Soaking Beans
18:00			Soaking Beans
19:00			Soaking Beans
20:00			Soaking Beans
21:00			Soaking Beans
22:00			Soaking Beans
23:00			Soaking Beans
00:00			Soaking Beans

The table 4 displayed a reduced work duration that prevent the risk of overworking, only from 7 AM to 4 PM with two batch of production daily, as opposed of model 2's 3 batches of production per day. With the schedule model on table 11, there are 60 batches of tempeh production on the 30 days (1 Month)

After every model that were possible were created, the next stage was to compares them with a production capacity analysis.

3. Potential Economic Improvement of GDL Chemical Acidification

The goal of stage 3 was to show that, the schedule that was suggested from the stage 2 of the experiment, was feasible to be used in the future, and to show that not only the productivity of the worker can be increased, but also the profit of each schedule for 1 month full of operation, so it can be calculated easily. But before calculating the profit, the productivity of each model must be tested

The potential for the new method was astounding since it can double or triple the batch of the tempeh at the expense worker's increased salary since 2-day schedule will be merged into one giant schedule, and it will affect the worker's salary and time

management, hence further discussion with the Artisan's and the employee must be done.

Implication was used for this analysis, the weight of the tempeh was used to calculate the productivity, and the weight was 500 gram of tempeh each.

The analysis of Productivity is done by subtracting the Weight of tempeh for each model for 1 month and was compared on table 5.

Table 5. Production Capacity Analysis

Model	Tempeh Production Schedule	Production Capacity Increase (%)	Tempeh Pieces Sold for 30 days (1 Month)	Tempeh Sold's Weight for 1 Month (Kg)
Model 0	1 Batch Natural Method	Normal	13020	6510000
Model 1	2 Batches of GDL Method	100%	26040	13020000
Model 2	2 Batches of GDL Method + 1 Batch Natural	200%	39060	19530000
Model 3	1 Batch of GDL Method + 1 Batch Natural	100%	26040	13020000

Model 0 means the natural method, model 1 is the 2 times GDL method, Model 2 is the Model 1 + 0, Model 3 is 1 GDL production + 1 normal production method

Table 5 displayed that between the three models that were constructed, the one who had the biggest productivity increases was model 2 which had increased productivity for up to 200% compares to normal method/model 0, followed by model 1 which was increase from the model 0, and model 3 was similar to the model 1, increased the productivity from the model 0 to 100% more productivity.

Figure 4 was created to show that the model 2 had increased the most compared to another model.

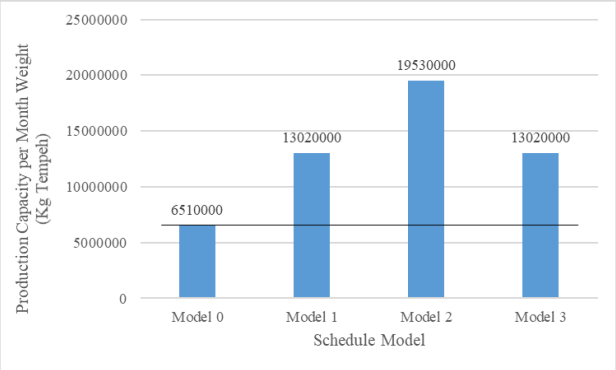

Figure 4. Productivity of Scheduling Model 0, 1, 2, and 3 for 1 Month of Productions.

Figure 4 showed that all of three model can be concluded to be able to increase productivity, there were another step that is need to be done to show if the model can be applicable on the real situation, by calculating the profit for each model to compare, that the profit can increase for the models, since it is possible that, even the productivity increase, the profit may not, so proper analysis will be done in the next stage.

The formula for calculating profit was the revenue substracted by the total production cost.

$$Profit = Revenue - Total\ Production\ Cost \quad (1)$$

One of the variables that was used for the economical calculation was the price for each of the raw material used for the production, and the price will be adjusted depends on each model since the required raw materials, wages, and electricity and water usage can be different for each model, due to different number of production batch. The formula was used for all the model for comparison.

Potential Revenue Improvement

The revenue was total sale for one day multiplied by 30 that stands for 30 days of production.

$$Revenue = Total\ Sales\ 1\ Day * 30 \quad (2)$$

Total Tempeh Sales

The total sales for one day was the tempeh price multiplied by the amount of tempeh sold for 1 batch, that was displayed on table 6. The table was based on the model 0 (current method) daily production, a 100 kg of soybeans can be created into 434 pieces of tempeh daily.

Table 6. Daily Tempeh Production Pricing and Pieces

Tempeh types	Produce Daily (Block)	Price/piece (Rp)	Total (Price) Rupiah
500 gram block	127	Rp3.500	Rp444.500
1 kg Block	86	Rp7.000	Rp602.000
Long Barrel, cut in 13 pieces/ 500 gram each	169	Rp3.500 (Per Pieces)	Rp591.500
Long Barrel, cut in 13 pieces	52	Rp3.500 (Per Pieces)	Rp182.000
Total	434		Rp1.820.000

The tempeh Types and price data were obtained by interview with the Ipeh Tempeh House Owner, table 6 was the amount of tempeh and pricing of the tempeh of model 0 that would be used for model 1, 2, and 3, with the assumption that table 6 was the amount of tempeh that can be produced for one batch.

Total Tempeh sales for each model

With assumption that the daily production was always the same even with multiple batches of tempeh, the calculation was only needed to be multiplied by the number of productions per day.

The total sales of tempeh were calculated with the formula number 3

$$Total\ \ Sales\ 1\ day = \sum(Amount\ of\ Tempeh\ types\ that\ can\ be\ produced\ daily\ x\ \ Price\ of\ said\ Tempeh\ Types) \quad (3)$$

By multiplying the sales number with the production batches for each model, since the implication used in the beginning was the tempeh, no matter how many, was always sold out. The formula (2) was used to calculate the revenue / sales of each model.

The total sales for one day then was multiplied by 30 that stands for 30 days in one month.

Table 7. Model Tempeh Sales for 1 Month

Number	Model	Sale 1 for Day	Sales for 30 days
1	Model 0 (Normal)	Rp1.820.000	Rp54.600.000
2	Model 1 (GDL 2 x)	Rp3.624.000	Rp108.720.000
3	Model 2 (GDL 2x + Normal)	Rp5.436.000	Rp163.320.000
4	Model 3 (GDL + Normal)	Rp3.624.000	Rp109.200.000

Table 7 indicated the revenue that the Tempeh house have for 1 month. To obtained the profit, total production cost was also needed to be calculated, the formula for the production cost or variable cost was the cost of goods/ raw materials addition of cost of wages for each model, with addition of the gas, water, and electricity cost.

Expected Rise of Total Production Cost

Other important component of profit calculation was the total production cost of the tempeh model, to calculate the production cost, variable cost and production expenses cost was needed.

$$Total\ Production\ Cost = Variable\ Cost\ + Production\ Expenses \quad (4)$$

Variable Cost

$$Variable\ Cost = (Soybean\ Usage\ Cost + Tempeh\ Starter\ Usage\ Cost + GDl\ Usage\ Cost + Plastic\ Usage\ Cost \quad (5)$$

The cost of goods / the material cost was divided into the raw soybean cost, tempeh starter usage, the GDL usage, the amount of plastic usage. The raw material cost per batch and brand name was displayed on table 8.

Table 8. Material Used and Price Cost for the Economical Calculations

Number	Production cost		Cost 1 Production
1	Raw Soybean	100 Kilogram	Rp750.000
2	Tempeh Starter	250 gram/ 500 gram	Rp7.500
3	Electricity	70 Kilowatt (1352 Rp/KwH	Rp500.240
4	Water	Arround 450 L	Rp135.000
5		420 Litre(300 Rp/Litre)	Rp126.000
6	Plastic (3 sizes)	434 plastic	Rp34.720
		Rp80/pieces	
7	Gas	3 kg (30k / tabung)	Rp30.000
8	Worker	Rp18.333	Rp109.998
9	Hull	10 Kg	Rp3.000

The material that will be used was displayed at table 8, the soybean, tempeh starter, GDL, gas tanks, and all the plastic that was used for one production was displayed. The calculation of the profit will be based on 30 days of production, the formula to calculated the profit needed the number of the raw material. The formula 5 can be applied to other models as well.

Water and electricity were a part of the operating expenses, including the wage of the worker, which was also part of the variable cost.

Comparison of Potential Revenue, Cost and Profit

Production Expenses

$$Production\ Expenses\ per\ Model = Gas + Water + Electricity + Wages$$

To calculated the total production cost, the variable cost and the production expenses needed to be calculated for each model before it was added together.

From formula (5), After the raw material cost was covered for each model schedule, production expenses in a form of Electricity, gas, wages will be calculated. And will be added to the total cost.

The Total Production Cost after each variable of the for total production cost was done with the table 9 that showed the total production cost of each model schedule with the variables from the soybean usage per month to the wage of the worker in Ipeh Tempeh House.

Table 9. Total Production Cost of Each Model Schedule

Cost Unit	Usage					Cost / Month			
	Unit	Model 0	Model 1	Model 2	Model 3	Model 0	Model 1	Model 2	Model 3
Raw Soybean	Kg	3000	6000	9000	6000	Rp22.500.000	Rp45.000.000	Rp67.500.000	Rp45.000.000
GDL	gram	0	122496	122496	61248	Rp0	Rp2.817.408	Rp2.817.408	Rp1.408.704
Tempeh Starter	gram	3000	4500	7500	5250	Rp18.000	Rp27.000	Rp45.000	Rp31.500
Plastic Packaging	piece	13020	26040	39060	26040	Rp1.041.600	Rp2.083.200	Rp3.124.800	Rp2.083.200
Gas	tank	30	60	90	60	Rp1.800.000	Rp3.600.000	Rp5.400.000	Rp3.600.000
Water	Litre	16080	20949,6	41049,3	30574,5	Free	Free	Free	Free
Electricity	kWh	5024,925	5237,4	10262,325	7643,625	Rp6.801.202	Rp7.095.972	Rp13.897.174	Rp10.349.188
Wage	person	1	1	2	1	Rp3.300.000	Rp6.599.880	Rp13.199.760	Rp4.949.910
TOTAL COST						Rp34.560.802	Rp65.423.460	Rp103.284.142	Rp65.622.502

Usage and Cost were Calculated Monthly

The water was freely flowing from the well near the production, so the price was free and the electricity price accounted the pump usage. The wage of the worker was different in each model, since it depended on the workhour of each schedule model, and in model 2 calculation, there were two workers suggested in order to balance the work that was needed to be done in one day.

The unit For GDL was called a replacement for each usage due to backslopping was implemented within the production, the amount of GDL was always the same, but the difference was on the replacement time for models that used GDL method, more GDL batches that was produced, more GDL solution replacement was needed.

Table 10. Profit Comparison Between Each Model for 1 Month of Production

Schedule Models	PRODUCTION COST	Revenue	Profit
Model 0	Rp34.560.802	Rp54.600.000	Rp20.039.198
Model 1	Rp65.423.460	Rp108.720.000	Rp43.296.540
Model 2	Rp103.284.142	Rp163.320.000	Rp60.035.858
Model 3	Rp65.622.502	Rp108.720.000	Rp43.097.498

Table 10 showed the profit for each model were Increased compares to the Model 0, with the highest is with model 2, which has 3 batches per day, even though the cost increased, but the profit also increased. Figure 6 shows the profit for each model schedule was better than the model 0 or standard model.

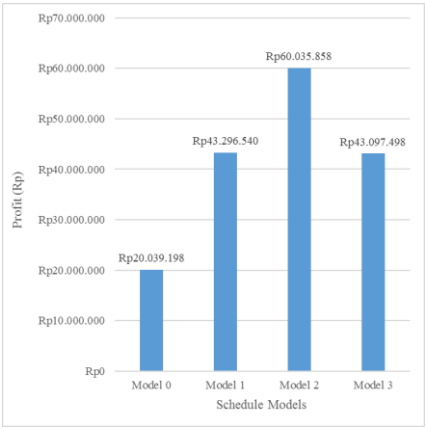

Figure 5. Profit Comparison Chart Between Each Model for 1 Month of Production

This conclude that every model that were suggested can be used in the Tempeh House, so they can adjust their production model according to the demand that they may had in the future, although there are several assumptions that must be eliminated.

CONCLUSION

Based on the potential economic calculation on the profit the new GDL acidification method, all the model schedule suggested can potentially increase the production capacity and the revenue without any addition in equipment, and space on the production line. Even though the production cost is inevitably going to increase due to the addition of GDL and multiple tempeh production can be happened during single day, but the profit that the suggested model can be potentially higher than the natural acidification method.

But since only the hypothetical and potential calculation that has been done, the real calculation and the GDL application treatment have not yet been done and the real result have yet to be seen.

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