DESIGN, FABRICATION, AND TESTING OF SIMPLE TOOL FOR LODGED PADDY RICE

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DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed…… (Mohamad Hafizi Bin Bahshon)

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This thesis is the result of my own investigations, except where otherwise stated.

Other sources are acknowledged by giving explicit references.

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LIST OF ABBREVIATIONS

USM	Universiti Sains Malaysia
PVC	Polyvinyl chloride
CNC	Computer numerical control
DIY	Do it yourself
PAR	Photosynthetic active radiation

ABSTRAK

Padi rebah berlaku berlaku apabila batang pokok padi tersebut menjadi lemah sehingga tidak dapat menampung berat biji padi yang menyebabkan ia jatuh. Kejadian padi rebah memberi impak yang tinggi dalam penanaman padi kerana pengeluar berusaha untuk mendapatkan pengeluaran padi yang tertinggi, ini menambah masa dan jumlah perbelanjaan dan sering mengakibatkan kehilangan hasil yang besar. Banyak alternatif telah diambil untuk mengelakkan masalah padi rebah seperti penggunaan baja berasaskan kimia dan kaedah penyemaian yang berbeza tetapi malangnya masalah itu masih berlaku. Pada masa ini, tiada alat yang sesuai untuk menyelesaikan masalah penginapan. Sebaliknya, kebanyakan mereka lebih tertumpu kepada menghalang masalah tersebut berlaku daripada menyelesaikannya. Jadi, projek ini akan bertujuan untuk menghasilkan alat baharu yang harganya murah, bahan mesra alam, dan mudah digunakan oleh pesawah untuk menyelesaikan masalah padi rebah. Keperluan reka bentuk yang diperoleh daripada tinjauan kemudiannya diterjemahkan ke dalam konsep reka bentuk. Reka bentuk terbaik dipilih berdasarkan kumpulan reka bentuk dan maklum balas daripada pelanggan. Daripada prototaip yang dihasilkan, pemasangan dan kajian masa menggambarkan bahawa produk akhir pastinya dapat membantu petani menyelesaikan masalah padi repah dan pada masa yang sama mengurangkan kerugian daripada masalah tersebut.

ABSTRACT

Lodged paddy rice occurs when plant stems weaken to the point they can no longer support the weight of the grain causing it to fall over. Lodging is increasingly important in rice cultivation as producers strive for the highest grain output yet, this adds to harvest time and expense and frequently results in considerable yield loss. Many alternatives have been taken to prevent the lodging problem such as the usage of chemicals based fertilizer and different method of sowing but unfortunately the problem still occur. Currently, there are no proper tool to solve the lodging problem. Instead, most of them are more to prevent the problem from happen rather than solve it. So, this project will aim to produce a simple tool that are cheap in price, environmentally friendly material, and easy to be used by the farmer to solve the lodged paddy rice problem. Design requirements obtained from the survey were then translate into design concept. The best design is selected based on designs pool and feedback from customer. From the produced prototype, assembly and time study depicted that the final product will surely able to help the farmer solve the lodged paddy rice problem while at the same time reduce the loss from lodging.

Chapter 1 INTRODUCTION

1.1 Research Background

Rice has become the most important staple food for every races and religions in Malaysia although rice is the second most important crop around the world after wheat[1]. The largest producer and consumer for both products are mostly from Asia's countries. The rice was consumed by every Malaysian daily. Nasi lemak, laksa and pulut kuning are some of the examples of rice-based food that famous in Malaysia[2]. Usually, the farmer will use chemical fertilizer for the paddy rice in order to get the best result possible. Ammonium sulphate (NH4)2SO4 is the most suitable and commonly used for paddy field[3]. Rice farmers commonly apply the N-fraction in the ammonium form of ammonium sulphate to flooded soils because nitrate-based fertilizers are ineffective due to nitrogenous waste losses. This can help the farmer to keep the soil fertile, allowing the farmer to grow nutritious and healthy crops. Fertilizers are used by farmers because they contain plant nutrients including nitrogen, phosphorus and potassium. With the combination of a good soil and the usage of suitable fertilizer, most of the paddy rice can grow healthily and has a good quality of rice. Unfortunately, an unhealthy paddy rice can still occur which is known as lodged paddy rice. Lodging is the bending over of grain crop stems around ground level, which makes harvesting difficult and reduces production considerably[4]. In cereals, lodging is frequently caused by a combination of factors including the crop's lack of standing power and environmental factors such as rain, wind, hail, topography, soil, preceding crop, and others. Nowadays, a consistent production of rice is important in order to keep up with the increasing of population in Asia[5]. Every farmer will try their best to have the best quality of rice not only because to sustain their income but also can help to fulfill the needs of every rice consumer. Many methods used by the

farmer to have a fine paddy rice such as using a correct tactic to seed the paddy rice, using the best soil for planting, using a chemical fertilizer to help the paddy rice grow healthier and much more. But in the end, an unwanted problem still occurs which is a lodged paddy rice.

There are a few efforts used by the farmers to solve the lodged paddy rice problem. The first one is by doing a suitable plant spacing. Proper and regular spacing between plants promotes healthy plant development and allows plants to withstand the effects of uncontrollable threats such as storms, severe rains, and illnesses[6]. Plants that are crowded or unevenly spaced have a tendency to lodge. In short, short inter row spacing should improve lodging resistance while reducing grain yields to a minimum. Secondly by clipping and grazing. This should be done before stem elongation has progressed far enough to harm the epics. Clipping or grazing, it appears, should be done without excessive soil compaction, and enough moisture and nutrient supply must be available over the following time to ensure high grain yields. However, it is possible that this strategy will obstruct the accomplishment of maximum yield[7]. Last but not least, the easiest and common method used by the farmer is using fertilizer. Fertilizer application need to be carefully monitored by the farmer because nitrogen is really effective to prevent lodging. The timing of nitrogen application is critical in this situation. Reduce lodging by dividing nitrogen into two or three splits and providing as needed by the crop plant. The nitrogen, phosphorus, and potassium balance in the soil must also be considered[3]. When plants have a lot of nitrogen, it's very important to have enough potassium to keep them from lodging. To avoid the problem of lodging, it has been proposed that plant growth retardants and sulphur be used. Based on the above prevention methods, none of them using a mechanical tool to solve lodging problem aside from scissors for clipping and grazing method. Most of the methods

were applied at the early stage of planting. So, this project will aim to develop a new tool that can help the farmer to easily harvest the lodged paddy rice if the lodging problem still occur. The advantages of mechanical tool are it can be used multiple times with a single purchase, only need to be used when the lodging problem occurs, and suitable to use by all ages without any harms.

Figure 1.1 Example of lodged paddy rice happened in Malaysia

1.2 Problem Statement

One of the issues that causes farmers to lose money is lodging. The grain yield drop could be as much as 50%. Malaysia is one of the countries where rice is grown in high-yielding environments due to unforeseen weather conditions. During the grain loading time, lodging is commonly caused by bad weather such as strong winds and heavy rainfall. Farmers utilize a variety of solutions such as chemical based fertilizer. Unfortunately, this issue still persists. Furthermore, long use of chemical may cause to soil crust and acidification. To overcome this challenge, a new mechanical tool will be developed in this project to solve the problem that cannot be solved by chemical fertilizer alone. The tool should be easy to use, cheap in price, and environmentally friendly.

1.3 Objectives

The specific objectives of this research are:

1. To conduct a feasibility study of mechanical tool in order for helping the farmers to solve the lodged paddy rice problem.
2. To design and fabricate a prototype of a simple mechanical tool for testing on lodged paddy rice.

1.4 Scope of research

This project is limited to solve the lodged paddy rice that only happen in Malaysia. Other countries may have different properties of paddy rice compare to Malaysia which may need a different kind of approach. The material selection also limited to specific materials because the material used should be an environmentally friendly material and also cheap in price.

Chapter 2 LITERATURE REVIEW

2.1 Introduction to paddy rice

Rice has become the most important staple food for every race and religion in Malaysia although rice is the second most important crop around the world after wheat. The largest producer and consumers of both products are mostly from Asia countries[8]. The rice was consumed by every Malaysian daily. Nasi lemak, laksa and pulut kuning are some of the examples of rice-based food that are famous in Malaysia.

Rice is grown in a unique way compared to other grains because it is a semi-aquatic plant that requires regular watering throughout the growing season. Heavy clay and silt loam soils, which are generally unsuitable for other crops, hold a lot of water and are ideal for rice. Rice flourishes in warm climates. On the Malaysian Peninsula, it is widely grown. Rice is grown on over 300,500 hectares in the Malaysian Peninsula[2]. The country's climate and rainfall distribution are ideal for rice cultivation all year. Most local farmers usually grow and harvest rice roughly at the same time. After soaking the seeds in water, they are ready to plant. Before being delivered to rice fields, rice seeds are sowed in special seedbed. Rice requires three to four months to grow properly. Rice harvesting must be done at the proper time.

Usually, the farmer will use chemical fertilizer for the paddy rice in order to get the best result possible. Ammonium sulphate (NH4)2SO4 is the most suitable and commonly used for paddy field. Rice farmers commonly apply the N-fraction in the ammonium form of ammonium sulphate to flooded soils because nitrate-based fertilizers are ineffective due to nitrogenous waste losses[3]. This can help the farmer to keep the soil fertile, allowing the farmer to grow nutritious and healthy crops.

Fertilizers are used by farmers because they contain plant nutrients including nitrogen, phosphorus and potassium.

2.2 Occurrence of lodged paddy rice

With the combination of a good soil and the usage of suitable fertilizer, most of the paddy rice can grow healthily and has a good quality of rice. Unfortunately, an unhealthy paddy rice can still occur which is known as lodged paddy rice. Lodging is the bending over of grain crop stems around ground level, which makes harvesting difficult and reduces production considerably. In cereals, lodging is frequently caused by a combination of factors including the crop's lack of standing power and environmental factors such as rain, wind, hail, topography, soil, preceding crop, and others[9].

A variety of studies have documented yield loss in many type of different crops, as well as the physiological causes of yield reduction related to lodging. Table 2.1 shows reduction in yield for different crops due to lodging. As we can see, yield loss for rice can become the highest loss which is up to 83.9% loss[10]. Lodging can occur at any stage of growth. However, lodging during the reproductive period, such as anthesis or during grain filling, leads into a significant yield drop, whereas lodging during the early reproductive or vegetative growth stages results in a smaller yield reduction.

Table 2.1 Reduction in the yield of crops due to lodging stress

Crops	**Yield loss (%)**
Wheat	12-80
Rice	4.9-83.9

Barley	4-65
Oats	37-40
Maize	5-20

2.3 Type of lodging

According to previous research, lodging can be categorized into two major types which are stem lodging and root lodging[11]. Stem lodging usually occur later in the season, when the stalk becomes more brittle as the crop matures. When the forces that causes deflection surpass the elastic limit of the stem, lodging might occur[12]. It may be calculated by adding the external forces and taking into account plant height, stem elasticity, and stem diameter or thickness at the same time. It only affects plants that are securely held in place by a dry, hard top soil layer. Figure 2.1 shows the image of stem lodging.

Root lodging on the other hand happened when the root of the paddy rice fail and the entire plant will bend or falls over. Root lodging also refers to straight and undamaged culms leaning from the top, causing root system disruption[13]. It happens at the start of the season. The crown or higher section of the root system is generally where the breakage or bending occurs in root lodging. It occurs in damp soil, with gaps running parallel to the planting rows on the opposite side of lodging. Figure 2.2 shows the image of root lodging.

There have been many successful approaches to overcome stem lodging so far, including traditional breeding and biotechnology, reducing and delaying nitrogen levels, adding potassium and phosphorus, hilling, and the use of plant growth regulators at stem extension to obtain shorter and better stems[14]. In short, most of

the stem lodging problems can be solved by using chemical fertilizer and does not need external help for example from mechanical tool.

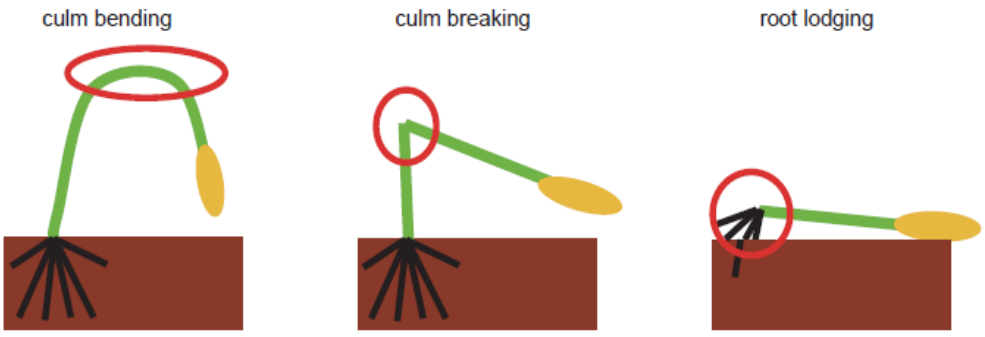
Figure 2.1 Stem lodging

Figure 2.2 Root lodging

According to field surveys in the North China Plain, it showed that root lodging occurred more frequently compare to stem lodging for the past recent years[15]. There are also some cases where 100% of the lodging problem are from root lodging and none from stem lodging. So far, however, little to no systematic study has been conducted to address this issue yet.

Based on the other research, cereal crops can be divided into three types of lodging which are culm bending, culm breaking and root lodging[16]. The first form

of lodge is culm bending-type lodging, which happens when plants cannot withstand bending pressure, as observed in the higher internodes of rice plants exposed to heavy winds and rain. The second form of lodging is culm breaking lodging, which commonly affects the lower internodes when the higher internodes are under too much bending pressure. The form and quality of the culm have a big impact on this sort of lodging. Root lodging is the last form, which occurs when the roots collapse under the weight of the above-ground components. Because transplantation promotes the establishment of a well-established root system, root lodging is rarely a big issue with transplanted rice. This, however, may have a negative impact on those planted using the direct-seeding method, since plants have a propensity to have shorter root systems. Figure 2.3 shows the images for three types of lodging in rice.



(a) (b) (c)

Figure 2.3 Three type of lodging in rice

Dwarfism have been used to improve the resistance of culm bending and breaking type lodging. Dwarfism in crops lowers the plant's "center of gravity," which reduces the time it takes to lodge. Some special enzyme has been used for dwarfism method which might be used to develop new methods for breeding plants with altered fiber content, as well as high-yielding or lodging-resistant crops[15]. This research also shows that the usage of chemical substance can help to prevent the culm bending

and culm breaking lodging problem but still cannot fully solve the root lodging problem.

The root development can be improved due to two main reasons which are by increasing soil temperature and decreasing the soil water availability in order to encourage rice root development and the buildup of dry matter, and the other one is by significantly increases in aboveground biomass in order to meet the increased demand for water and nutrients which stronger root systems are required to sustain. These solutions need a really precise execution to get the best result.

To conclude, stem lodging problems already can be easily solved by chemical substance while root lodging problem is still quite hard to solve by chemical approaches alone. So, this project will solely focus helping the farmer to solve root lodging only instead of all type of lodging. So, the simple mechanical tool that will be developed in the future can be used exclusively to solve root lodging because that type of lodging required more effort to prevent it. In short, the design of the tool will be very simple and not so complicated which resulting into ease of use for the user and cheaper in price.

2.4 Lodging resistance

Due to its impact on grain yield and quality, lodging resistance is a crucial feature in the cultivation of rice. The short plant height, the robust physical strength of the culms, and the sturdiness of the bottom portion of the plant are the three key goal types for lodging resistance that are significant for rice breeding. The first lodging resistance aim in rice breeding research was to reduce plant height, which helped the Green Revolution produce high-yielding rice[17]. Additionally, breeding operations genetically enhanced the plant's physical toughness, particularly the culms. Without

affecting the plant type, the culm strength or sturdiness of the lower portions can resist lodging. Grain output or biomass may be negatively impacted by low plant height for lodging resistance since the maximum amount of photosynthetic potential in a canopy requires the ideal plant height. A helpful strategy for increasing grain production or biomass in plant breeding is to modify culm strength or sturdiness, which, in contrast to lowering plant height, results in increases in the physical strength of the plant body.

Morphological characteristics and chemical components affect the physical strength of the culm. Regarding morphological characteristics, cereal culms' resistance to bending is influenced by both wall thickness and diameter. High physical strength is also known to have cortical fiber tissue thickness and culm weight. When changing culm morphology, these characteristics are strong culms' primary goals. The physical toughness of a plant is often determined by the structural carbohydrates cellulose and lignin. The most significant mineral component impacting culm strength is silicon content[14].

There are two basic categories in which to place the origin of strong culms. The first is the enhancement of the culms' maximal physical strength after heading, and the second is the avoidance of a reduction in that strength from the grain filling stage to the completely ripe stage[18]. From heading until grain filling, the physical strength of rice culms peaks, and genetic variables influencing culm strength at this period have been examined in various lodging resistance research. It follows that finding morphological features or chemical components in culms that stop strength degradation constitute important targets for advances in lodging resistance in rice breeding as the lower physical strength of culms after grain filling is a known cause of rice lodging.

A close correlation exists between lodging resistance and the structural carbohydrates cellulose and lignin, which are crucial chemical elements for the physical strength of a plant body. A culm brittleness mutation revealed low cellulose content in brittle strains caused by a reduced amounts of cellulose molecules in the cell wall. Cellulose content corresponds with maximal bending stress in barley. In rice, the brittle culm phenotype is caused by a reduction in cellulose that will reduce the cell wall thickness, thus leading to lower mechanical strengths of culms.

2.5 Factors affecting lodging

2.5.1 Light and temperature

The equilibrium between longitudinal and transverse vascular tissue growth is governed by light intensity. High intensities prevent natural gibberellin from promoting cell division and elongation by blocking its function. Low light levels encourage internode lengthening and thin the culm walls. Low light intensity may also be detrimental to root development. Increased temperature may indirectly encourage internode elongation because of its impact on the release of soil nitrogen. The length of the barley culm and temperature were shown to be significantly correlated from seedling emergence through heading. Wheat stem and root features were more vulnerable to lodging when light integrals (also known as PAR, or photosynthetic active radiation) and light quality were reduced[19].

2.5.2 Fertilization

Plants tend to grow taller at the extent of their stem strength when there is an excess nitrogen fertilization. Extreme weather conditions can cause lodging to happen very early in a plant's life. Small grain prolific tillering often results in excellent stem

strength and minimal lodging. A weak stem can develop from excessive tillering under conditions of high nitrogen productivity. When soil potassium levels are low, fewer sclerenchyma tissues are formed in the stems, which results in weaker stem tissues[3]. All plant components grow more slowly when phosphorus levels are low, and stems and roots frequently fail to form properly. The stems and roots may be less able to withstand the stresses that lead to lodging in this weaker state.

2.5.3 Soil moisture and aeration

High water tables cause root depth to decrease and possible increases in lodging. However, if stems are extending quickly, adding more water speeds up their development and raises their vulnerability to flood. Small stems and leaves, as well as damaged root systems, are the effects of water stress. Sometimes it makes stem tissues weaker, which makes lodging more likely[20]. As a result of the effects of respiration limitation on changes in metabolism that encourage cell elongation, poor soil aeration may increase susceptibility to lodging.

2.5.4 Plant density

Plants that are planted too tightly have a tendency to quickly elongate. Plants may compete with one another, a situation known as intra-specific competition if the planting density is too high[21]. The place between each plant will become smaller if the planting density is higher. In certain circumstances, a plant's performance turns into a limiting factor for the greatest crop output. As a result, plants are more prone to lodging and their stems grow lighter and thinner. High plant populations alter the local microclimate, which has an impact on lodging. In addition, high planting densities also prevent photosynthesis, which causes seedlings to rot and reduce yields.

2.5.5 Soil type

Soil type can influence lodging. For example, the black soil zone has a high percentage of land with 6-8 percent organic matter, which gives a larger reservoir of N for plants to draw on, thereby increasing the risk of lodging[22].

2.6 Current prevention of lodging

2.6.1 Cultivar selection

The first line of defence against lodging is to choose a cultivar with short, sturdy straw. Increasing the length of the uppermost internodes, the thickness of the stem wall, the amount and density of mechanical tissue, the amount of vascular tissue, the amount of stored carbohydrates in the stem, the amount of silicon and potassium, and mapping quantitative trait loci for the lodging resistance have all led to the development of cultivars that are resistant to lodging[23].

2.6.2 Fertilizer

The resilience of the rice stem and its resistance to lodging are improved by fertilizer with an appropriate ratio of nitrogen, phosphate, and potassium. Applying silicon fertilizer specifically encourages the growth of the root system, resulting in tall, straight plants with rigid stems and sturdy stem bases. The need for enough potassium to prevent lodging is especially critical when plants have access to abundant nitrogen. Sulfur and plant growth inhibitors have been recommended as ways to avoid lodging issues[3]. The capacity to resist rice blast and rice smut is considerably enhanced by silicon fertilizer in terms of disease resistance.

2.6.3 Date of sowing

A good sowing date might occasionally lessen the likelihood that the plants will be at a development stage that makes them particularly prone to lodge during a time when lodging-inducing elements are frequent. There are ideal planting dates for each crop and cultivar, with lodging often being lower when crop is planted during ideal time. Winter cereals that are planted too early may have excessive vegetative development, which makes the plants more susceptible to lodging[24].

2.6.4 Method and depth of sowing and row orientation

The root crown's depth and length expand as a result of deep sowing. As a result, plants may be better able to attach themselves to the soil, increasing their resistance to lodging. Stem lodging may be prevented by sowing in drill rows in a direction parallel to the strong wind's direction of predominance[20]. Due to their impact on light absorption, this should also be included when analysing the impacts of plant row orientation on yield. Bed planting irrigated spring wheat may be advantageous when chronic lodging occurs since bed planted genotypes showed over 50% reduced lodging compared to flat planting.

2.6.5 Plant spacing

Establishing a suitable and consistent distance between plants promotes healthy plant growth and enables plants to withstand the onslaught of unforeseen threats like storms, heavy rains, and illnesses. Plants that are crowded or have limited room often lodge[21]. In conclusion, tight interrow spacing should improve lodging resistance without, to put it mildly, reducing grain output.

2.6.6 Irrigation practices

Proper watering and drainage encourage the growth of roots and above-ground plants, which lowers the likelihood of lodging. Reduced plant height and early vegetative development considerably lower the likelihood of lodging during and after subsequent watering[22]. This suggests delaying spring irrigation as long as feasible, ideally until the early boot stage.

2.6.7 Crop rotation

Crop rotation is essential for preventing diseases including scald, net blotch, root rot, and common root rot. The less severe the disease pressure is when a cereal crop is planted in broad leaf crop stubble, like canola or flax[22]. Crop rotation techniques might be especially crucial for farmers that use irrigation. A crop rotation plan is helpful for the preservation of soil fertility, disease prevention, and weed control in the absence of summer fallowing. Additionally, malt barley and soft white spring wheat can also benefit from proper rotations to help reduce their protein content.

2.6.1 Clipping and grazing

Clipping and grazing can help avoid lodging caused by too much foliage at the time when the bottom culm internodes are extending. Before culm elongation has advanced enough to harm the epics, this should be done. It would appear that in order to guarantee excellent grain yields, trimming or grazing should be carried out without too compacting the soil, and the ensuing period must have sufficient access to moisture

and nutrients. It's believed that this approach could prevent the highest yield from being achieved.

Grazing decreased lodging on grazed plots by 94% compared to ungrazed plots. It could be because there is a relationship between plant height and lodging since grazing causes plants to grow more slowly than they would in ungrazed areas. The yield percent reduction, yield components, and lodging caused by grazing in wheat are displayed in Figure 2.4 [7].

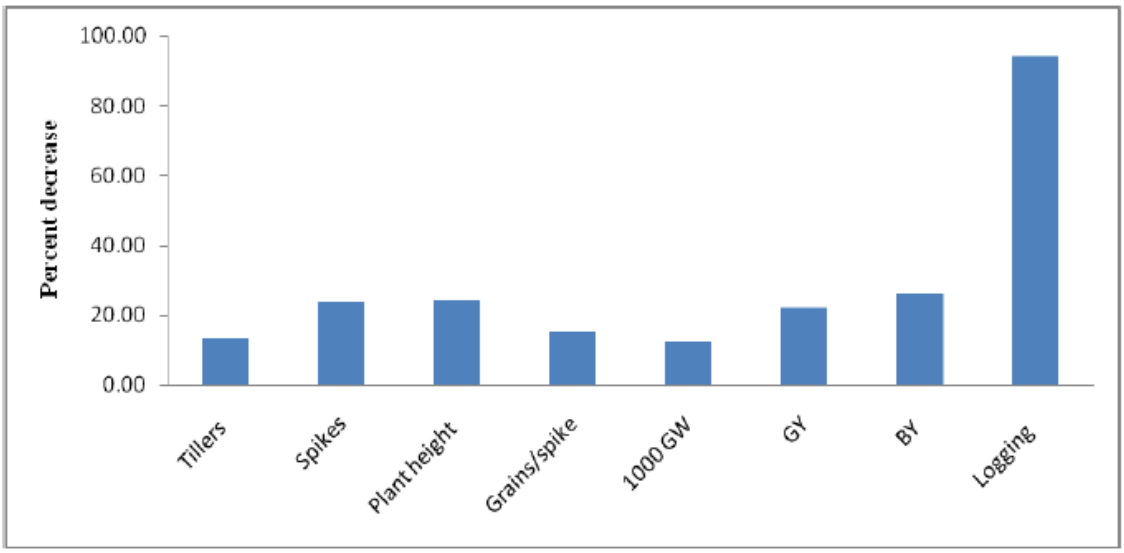


Figure 2.4 Percent decrease in yield, yield components and lodging by grazing in wheat.

2.9 Mechanism of existing products

In order to have a functional product, the mechanism of that product should be properly considerate. So, the currently existing products' mechanism will be referred as the benchmark to produce the new tool. In this case, I mainly referred to the mechanism of a sickle and tongs to produce new products. A sickle, bagging hook, reaping hook, or grasshook is a single-handed agricultural equipment with differently curved blades that is typically used for cutting succulent forage, either freshly cut or dried as hay, or harvesting grain crops. Falx was a synonym that was later used to

refer to any variety of implements, including scythes, that had curved blades with sharp edges[25]. From this design, I decided to change instead of cutting the paddy rice, the new design will only hold the paddy to raise it from lodging properly. So afterwards the paddy machine can harvest it easily.

The next products are about tongs. Tongs are a type of tool used to grip and lift objects instead of holding them directly with hands. There are many forms of tongs adapted to their specific use[26]. The mechanism of the new design is still the same as the normal tongs and the only difference is the size of the product which the new product will be bigger in order to grip as much paddy rice as possible in one loop.

Figure 2.5 A image of current existing sickle and tongs

2.10 Summary

According to the previous research, none of them propose any solution for the lodged paddy rice by using any mechanical or automatic tools. Most of them only applied a chemical fertilizer or practice a suitable approach to solve or prevent the problem. Maybe somewhere in the world their already have the tool to solve the lodged paddy rice but the inventer did not publish their product which made the efficiency comparison between the currently existing product and this product cannot be accomplished.

Chapter 3 METHODOLOGY

3.1 Introduction

As this project is in it is first few steps, most effort was put on the planning and how to design the product. In order to get some rough idea, I need to watch a specific Youtube video provided by my supervisor regarding about the simple tool to solve lodged paddy rice. From the video, some of the concept can be taken such as the method used to lift the lodged paddy rice and how to make sure the paddy rice to stay up after lifted it. Some improvement can also be made to ensure the user feel more comfortable when using the tool. For example, the design of the simple tool should not force the user to crouch their body for to long while using the tool in order to avoid back pain especially for older people. Figure 3.1 shows some part of the video taken from the Youtube.

Figure 3.1 Some part from the Youtube video about simple tool to solve lodged paddy rice

Figure 3.2 shows the flowchart for this project.

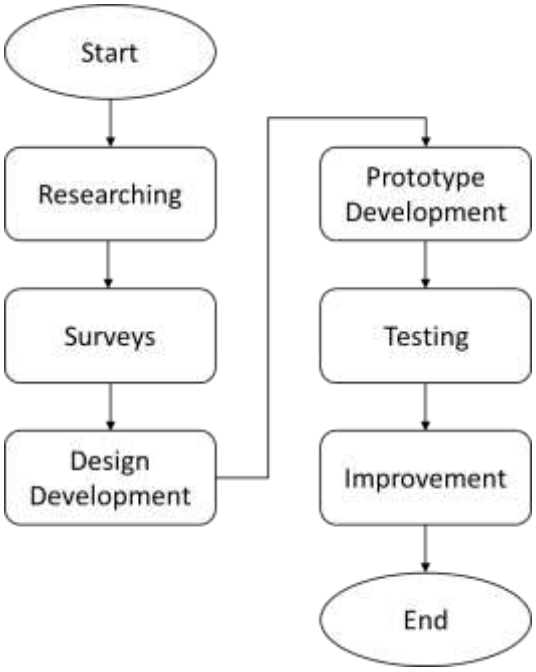


Figure 3.2 Project flowchart

3.2 Conduct a survey

As a first course of action, a suitable questionnaire is developed in order to get a better idea about the lodging problem from the experience farmer in Malaysia. The question should be short and simple as possible to avoid taking too much time from the respondent to answer the survey. The survey is divided into two stages where the first stage is focusing to get the main idea whether the farmers are affected by lodged paddy rice or not and how they currently prevent it while the second stage of survey is only focusing about desire design of the simple tool.

3.2.1 First stage survey

There was a total of 30 respondents involved in the survey question about lodged paddy rice. The same set of questions will be provided before surveying everyone involved. A hybrid approach is used to collect the data for the survey which are a

combination of a face-to-face interview and online interviews such as using Facebook and WhatsApp. Both of the data got will be converted into the google form to easily do the analysis. The survey questions for stage one is attached in appendix A. The objectives of the first stage survey are:

1. To determine whether the farmers are affected by lodged paddy rice or not.
2. To know how the farmers currently prevent or solve the lodging problem.
3. To know if the farmers desire the mechanical tool or not.
4. To investigate the farmers' desire specification for simple mechanical tools to solve lodged paddy rice.

3.2.1 Second stage survey

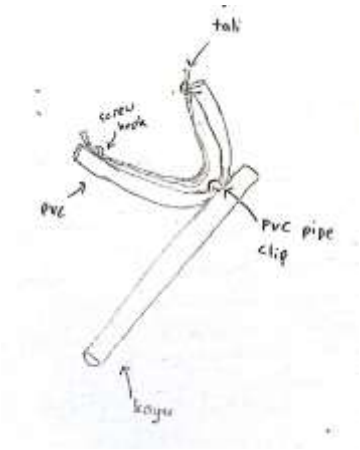
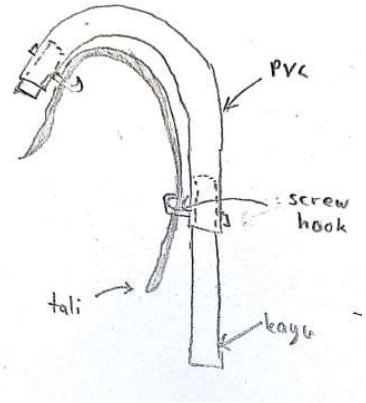
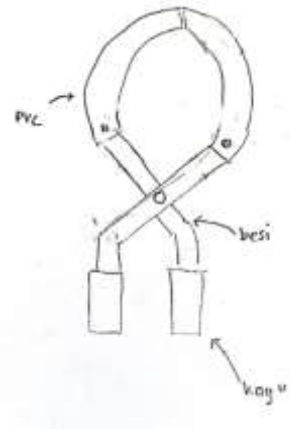
Most of the respondent participated for the second survey are the same as the first stage survey. The same approach also has been used for this survey which is by using hybrid approach. This survey will be executed when the conceptual design is done. The survey questions for stage two is attached in appendix B. The main objective of for the second survey are:

1. To identify the most desired design by the farmer from the given choice of designs.
2. To collect feedbacks from respondents about improvement that can be made for the conceptual design.

3.3 Conceptual design

A several design should be created in this stage. All design should be able to solve the lodged paddy rice problem while still cheap in price, easy to use, and environment friendly material. Table 3.1 shows three proposed designs for the simple tool.

Table 3.1 Design selection

	Concept 1	**Concept 2**	**Concept 3**
Design			
Price	Very affordable (RM5.00-RM10.00)	Very affordable (RM5.00-RM10.00)	Somehow affordable (RM30.00-RM40.00)
Ease of use	• Easy to use • Need to bow down to lift and tie the lodged paddy rice	• Very easy to use • Only need to use one hand to lift the lodged paddy rice	• Somehow easy to use • Need a second person to easily tie the lodged paddy rice
Major materials	PVC and wood	PVC and wood	PVC, wood, and steel
Safety	Quite safe to use (have some sharp point)	Quite safe to use (have some sharp point)	Safe to use
Weight	Light weight	Light weight	Quite heavy

Based on the second stage survey, most of the respondent choose concept 2 as their choice because it is the easiest and most comfortable to use by the user. Figure 3.3 shows CAD model of alpha version for design 2 concept which mean the design can still be improve in the future.

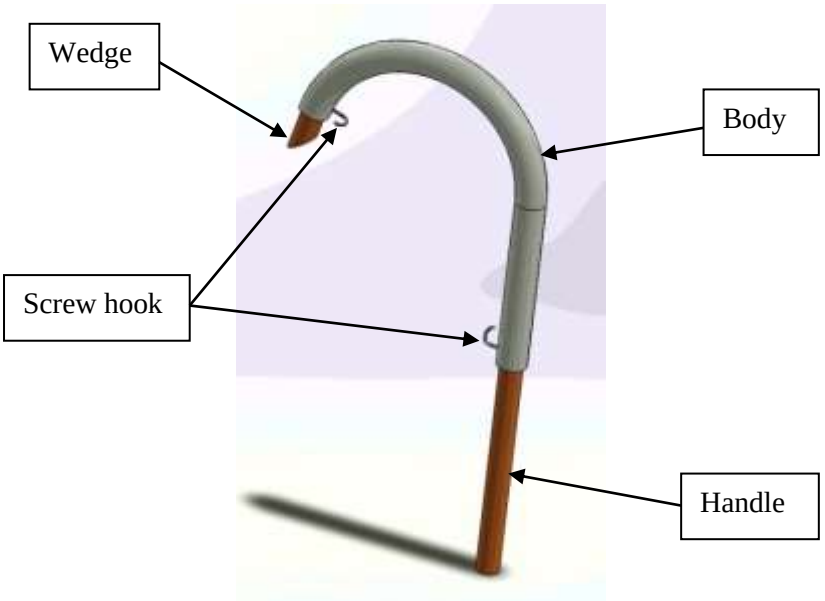


Figure 3.3 CAD model for alpha version

3.4 Parametric design

In the parametric design stage, the initial state of information is the configuration. To put it another way, almost everything about the planned product is known except its specific dimensions and tolerances[27]. The specific material choice may also be unclear in certain cases however the fundamental class of material will normally be mentioned in the configuration information[28].

Parametric design for the simple tool to solve lodged paddy rice was based on the anthropometric data for Malaysian workers. Table 3.2 shows the demographic background of the respondents while table 3.3 shows the anthropometric data of Mean and Standard Deviation for Malaysians Male and Female Workers[29]. Figures 3.4 and 3.5 show which part of the body the data was taken while in standing and sitting positions.

Table 3.2 Demographic Background of Respondents

Variable	Number (N)	Percentage (%)	Mean	Std. deviation
Age			32.56	9.49
30 years and below	613	54.2		
31 – 44 years old	363	32		
45 years and above	156	13.8		
Gender				
Male	863	76.1		
Female	271	23.9		
Ethnicity				
Malay	927	81.7		
Chinese	71	6.3		
Indian	105	9.3		
Others	31	2.7		
Marital Status				
Single	495	43.6		
Married	635	56		
Divorced	4	0.4		

Table 3.3 Mean and Standard Deviation for Malaysians Male and Female Workers

Anthropometry Dimension (cm)	Male		Female	
	Mean	SD	Mean	SD
Standing Posture				
Vertical Grip Reach	200.85	10.71	184.27	9.38
Stature	169.57	7.57	156.83	5.97
Eye Height	157.02	7.25	144.5	7.02
Shoulder Height	140.73	6.19	130.02	6.03
Armpit Height	125.31	5.84	115.81	5.2
Elbow Height	104.49	6.3	96.86	4.5
Hip Height	85.61	5.47	83.47	6.24
Knuckle Height	71.16	4.34	66.49	4.56
Fingertip Height	61.92	3.92	58.21	3.45
Tibial Height	44.47	3.11	41.37	3.33
Biacromial Breadth Right	16.5	2.51	14.9	2.49
Biacromial Breadth Left	16.2	2.42	14.4	2.51