UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF PINEAPPLE LEAF FIBRE EXTRACTION MACHINE

Universiti Teknikal Malaysia Melaka (UTeM)
Bachelor of Mechanical Engineering Technology (Maintenance) with Honours

by

NUR'AIN BINTI RAHIMAN
B071410609
930401016136

FACULTY OF ENGINEERING TECHNOLOGY
2017

DECLARATION

I hereby, declared this report entitled "Fabrication Of Pineapple Leaf Fibre Extraction Machine" is the results of my own research except as cited in references.

Signature	:	*NurAinRahiman*
Author's Name	:	NUR'AIN BINTI RAHIMAN
Date	:	26 December 2017

APPROVAL

This report is submitted to the Faculty of Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirement for degree of Bachelor Of Mechanical Engineering Technology (Maintenance) with Honours. The member of the supervisory is as follow:

MR. AHMAD NIZAM BIN JAMALUDIN

(Project Supervisor)

AHMAD NIZAM BIN JAMALUDIN
Jurutera Pengajar Kanan
Jabatan Teknologi Kejururteraan Elektrik
Fakulti Teknologi Kejuruteraan
Universiti Teknikal Malaysia Melaka

ABSTRAK

Malaysia mempunyai 1.2 juta tan bagi sisa tanaman yang harus dilupuskan setiap tahun. Daun nanas merupakan salah satu punca masalah bagi tanaman sisa di dalam sektor pertanian. Justeru itu, perancangan perlu ada untuk mengurangkan sisa tanaman daripada dibakar atau direputkan yang menyebabkan pencemaran alam sekitar. Lantaran itu, kajian ini bertujuan untuk mereka bentuk dan membina sebuah mesin peraut serat daun nanas. Mesin ini akan diuji kebolehannya untuk meraut daun nanas berdasarkan kelajuan motor yang berbeza. Ini kerana kajian terdahulu hanya dibuat mengenai perbezaan sudut pada mata pisau mesin peraut. Konsep daripada mesin peraut daun nanas ini adalah untuk meraut kedua-dua belah permukaan daun nanas dengan menggunakan mata pisau yang tajam bagi mendapatkan serat yang ada di dalam daun nanas. Projek ini ialah sebuah mesin serat daun nanas yang boleh meraut daun nanas bagi mendapatkan serat ini akan dapat diwujudkan. Mesin ini akan diuji kebolehan meraut daun nanas dengan mengoptimumkan kelajuan motor yang memusingkan mata pisau dengan bantuan pengepit daun.

ABSTRACT

Malaysia has 1.2 million tons of crop residue that must be disposed of every year. The leaves of the pineapple is one of the causes of a problem for the rest of the crop in the agricultural sector. Hence, there should be a plan to reduce waste from the plant is burned or decomposed which cause environmental pollution. Pineapple leaf also given value-added products for good approach in reducing the waste in the agriculture industry. Thus, the study is to design and fabricate a pineapple leaf fibre extraction machine. Besides that, it also to test and analyze the pineapple leaf fibre extraction machine by a different motor speed. This is because previous studies only made investigation on the difference in angle of knife scraper roller. The concept of extraction machine is breaking the leaf surface by using knife scrapper roller for scrap out the fibre. Therefore, this project is to design and fabricate a mechanism that can extract fibre from pineapple leaf. Besides that, testing and analyze of pineapple leaf fibre extraction machine based on the different speed of motor using knife scraper roller with the help of vise grip to extract the leaf.

DEDICATION

To my beloved family

ACKNOWLEDGMENT

I would like to thank to the almighty Allah for his blessing. All the process of idea,, concept, design and everything which in this project making is cannot be done without his blessing.

A million thanks to my supervisor, Mr. Ahmad Nizam Bin Jamaludin for supervise me in this project making from the beginning until end of this project. Thank you for the knowledge given, idea shared to make this project better, support given and also the time spend for this project.

I would like to express my gratitude to my lovely parents who had given lots of encouragement until the end of this project. I hope that this report will guide and reference to other students and researchers soon.

TABLE OF CONTENT

Declaration			i
Approval			ii
Abstrak			iii
Abstract			iv
Dedication			v
Acknowledgement			vi
Table of Content			vii
List of Table			x
List of Figures			xi
List Abbreviations, Symbols and Nomenclatures			xiii
CHAPTER 1: INTRODUCTION			1
1.1	Introduction		1
1.2	Problem Statement		3
1.3	Objective		4
1.4	Scope		4
1.5	Expected Outcome		4
CHAPTER 2: LITERATURE REVIEW			5
2.1	Natural Fibre		5
2.2	Pineapple		6
	2.2.1	Characteristic of Pineapple	7
	2.2.2	Pineapple Leaf	8
2.3	Pineapple leaf fibre		
	2.3.1	Feature of Pineapple Leaf Fibre	8
	2.3.2	Use of Pineapple Leaf Fibre	10
2.4	Process		
	2.4.1	Traditional process	11
	2.4.2	Mechanical process	12

2.5	Engineering Design			12
	2.5.1	Design		
		2.5.1 (a)	Define the problem	14
		2.5.1 (b)	Gather information	14
		2.5.1 (c)	Generate multiple solution	15
		2.5.1 (d)	Analyze and select solution	15
		2.5.1 (e)	Test and implement solution	15
	2.5.2	Manufacturing		15
	2.5.3	Material		16
	2.5.4	Manufacturing Process		18
CHAPTER 3: METHODOLOGY				19
3.1	Flow Chart			19
3.2	Detail of Methodology			
	3.2.1	Identifying Objective, Scope and Problem Statement		21
	3.2.2	Literature Review		21
	3.2.3	Collecting Data Information		21
	3.2.4	Brainstorming and Develop an Idea with Design		22
	3.2.5	Design Product		
		3.3.5.1	Design Blade	23
		3.3.5.2	Design of Product	25
	3.2.6	Selection Material Component		26
		3.2.6.1	Selection Material	27
		3.2.6.2	Selection Component	28
		3.2.6.2 (a)	Alternation Current Motor	28
		3.2.6.2 (b)	Bearing	30
		3.2.6.2 (c)	Belt Drives	30
	3.2.7	Fabricate Product		31
	3.2.8	Testing and Analyze Product		31

CHAPTER 4: RESULT AND DISCUSSION 32

4.1 Prologue Mechanism 32

4.2 Pineapple leaf fibre extraction machine 33

4.2.1 Explanation extraction machine 34

4.2.1 (a) Knife scraper roller 34

4.2.1 (b) Speed Control 34

4.2.1 (c) Motor 35

4.2.1 (d) Pulley and Belting 37

4.2.1 (e) Covering 37

4.2.1 (f) Manufacturing Body Machine 37

4.3 Additional mechanism 39

4.4 Operation of the mechanism 39

4.5 Resulting testing 40

CHAPTER 5: CONCLUSION AND RECOMMENDATION 43

5.1 Conclusion 43

5.2 Recommendation 44

REFERENCES 46

APPENDIX

LIST OF TABLE

2.1	Properties of pineapple leaf fibre	9
2.2	General manufacturing characteristics of various materials	17
3.1	The angle of scraper roller	22
3.2	Example of vise grip in different shape	22
3.3	Characteristic of Material	27
4.1	Result on extraction machine MD2 Leaf	40
4.2	Result on extraction machine Yankee Leaf	41
4.3	Result on extraction machine with vise grip	41

LIST OF FIGURES

2.1	Subdivision of natural fibre based on origin	5
2.2	Pineapple leaves and typical pineapple flower	7
2.3	Josapine Pineapple	8
2.4	Various present and future applications of pineapple leaves	10
2.5	Pineapple leaf fibre extraction by scrapping	11
2.6	Mechanical extraction of pineapple leaf fibre by decorticator machine	12
2.7	Stage of the life of product	13
2.8	Design Phase	14
2.9	Interrelationship among design, materials and processing	16
3.1	The process methodology	20
3.2	Knife scraper roller showing in (a)drawing in 2D with dimension (b) the shaft (c) the blade and (d)the side of blade of 45°. (e)isometric visual	24
3.3	Design of product by SolidWork 2016	26
3.4	AC motor	28
3.5	Bearing with casing	30
3.6	Belt drive	30
4.1	Pineapple leaf fibre extraction machine already being testing	33
4.2	The knife scraper roller in actually	34
4.3	KPE-LE02 Digital Keypad for VFD-E Series	35
4.4	Motor	35
4.5	Pulley and Belting that connection to motor	37
4.6	(a) Measuring and marking, (b) Cutting and (c) Drilling	38
4.7	Vise Grip Pineapple Leaf	39

4.8	MD2 Leaf	40
4.9	Yankee Leaf	40
4.10	Yankee Leaf with vise grip.	41
4.11	Pineapple Fibre	42

LIST ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

UTeM	Universiti Teknikal Malaysia Melaka
UTHM	Universiti Tun Hussein Onn Malaysia
PALF MI	Pineapple Leaf Fibre Machine 1
AC	Alternating Current
o	Degree
%	Percentage
s	Second
m	Minute
rpm	Rotational per minute
Hz	Hertz
Hp	Horsepower
W	Watt

CHAPTER 1
INTRODUCTION

1.1 Introduction

Decortication, abstraction and defibration are a different kinds of names that people have made-up the types of fibre extraction machines as early as 1900's. From the plant, all serve the sole purpose to extract fibre. This fibre from flax and kenaf were highly observed for sources in textile commercialization in United State of Canada and America (Yusof & Adam., 2013). That is the begin to start built the machine in extraction. The machine will improve by year with the technology according to the time distribution.

According to Patterson (1949) thought that in order to design a universal machine, condition either in dry or wet that provision must be made for handling stalks and leaves. That required generally different methods of treatment involving extensively dissimilar mechanical principles of handling.

Agriculture industry based on market to promotes non-food. That would release the possibilities usage for expansion of biocomposites has enlarged industrial to minimize the wastage of renewable materials (Asim et al., 2015). Pineapple leaf fibre has advantages in renewable energy and plentifully available which is potential as strengthening in composite material (Dahlan., 2016).

Lately, Malaysia in agricultural sectors has a critical issue on crop waste. Roughly 1.2 million tons of agricultural waste being disposed of yearly. Burned and

decomposed are that category reduce of waste which is a show to the increase of some environment issue. Changing waste into wealth not just makes good biological sense, but also changes "rubbish" into "money" (Yusof et al., 2015). Pineapple leaf the one of choose to plan production to reduce surroundings pollution and minimize the waste in the agricultural sector. It will build up the green environment in further develop economy growth.

Natural fibres are the types of fibre as a raw material for the textile industry which is obtained directly from nature. The natural fibres can be classified into two groups, namely fibres derived from animal fibre and vegeTable fibre. Ecological, renewable, low rate, low density and less health hazard are advantage natural fibre compared to synthetic fibre (Davindrabrabu et al., 2014). This can save the world to be more health for future in a new generation.

The vegeTable fibre obtained one of class fibre derived from plants which are pineapple leaf fibre. Pineapple or scientific name Ananas Comosus that including the family of Bromeliaceae. The country with largest pineapple grower in the world is United States, Thailand, Brazil and Philippines. In history 1599, this plant comes from Brazilian and brought to Indonesia by the Spanish and Portuguese sailors (Hidayat., 2008). Pineapple leaf contains 2.5 % to 3.5 % strong, white and silky textile grade fibre embedded by a top waxy layer within the leaf (Banika et al., 2011).

Separation process of pineapple leaf fibre that has two ways traditional and mechanical method. The traditional method is the manual ways to extract the fibre from leave using by hand but the mechanical method makes the easy and fast for human to extract the fibre (Yusof et al., 2016). From that method can get fibre most likely like a thread. After that, the process goes further to made of something in a industry such as textile. This is starting in the process to furthermore the industry which is can help people more income in life.

There are about 85 % to 88 % of pineapple leaves have been wasted form the method of hand scraping that not very sensible which the impact towards reductions

of pineapple leaf after harvesting from year 2008 until 2010 according to (Yusof et al., 2015). This make prove that the machine can help people to easy with the machine. Therefore, from using machine that can make decreasing on the wasted of pineapple leave.

1.2 Problem Statement

In agricultural sectors, there is a lot of waste produced after harvesting activities. Malaysia is a country that have rich source of agricultural waste material. Almost 1.2 million tons of crop residue that must be disposed of every year (Yusof et al., 2015). Therefore, pineapple leaf should make value-added products for good approach in reducing the waste in the agriculture industry (W.A.Ahmad et al., 2013). Besides that, another things make motivates to create this because of pineapple leaf can produce the leather from fibre which is does not harm animals anymore. This is one of the steps to overcome the problem of extinction. Thus, advantage of fibre from pineapple needs to save the beauty of the environment.

Investigation from Yusof et al. (2016) that show different process scraper between traditional and mechanical. Traditional process method by using hand scraping which is applies only one side of a surface to scrap. But in mechanical process by using extraction machine the surface of leaf will be scraped at the same time for both upper and bottom of leaf.

Besides that, as discussed by Adam and Yusof (2015) said that, it might damage the fibre when leaf was to close the blade but the leaf might not be fully extracted when it to far beyond the blades. Hence, the investigate about the feeding angle that shows 45° has a consistent result for extraction the pineapple leaf fibre. However, no previous studies done on effect of motor speed during the press of whittling the pineapple leaf fibre. In addition, the pineapple vise grip capable of holding more than one leaf will be develop to increase productivity of fibre extraction machine.

Therefore, in this study will increase productivity on the extraction machine would be investigation on different speed of motor using knife scraper roller with the help of vise grip to extract two leaf at a time.

1.3 Objective

The objectives are as follows:

(a) To design the pineapple leaf fibre extraction machine by using solid work.
(b) To fabricate the pineapple leaf fibre extraction machine.
(c) To test and analyze the pineapple leaf fibre extraction machine.

1.4 Scope

The scope of this study is based on the objective which are:

(a) Design and fabricate the pineapple leaf fibre extraction machine.
(b) Testing and analyze of pineapple leaf fibre extraction machine based on the different speed of motor using knife scraper roller with the help of vise grip to extract the leaf.

1.5 Expected Outcome

The expected outcomes of this project is to design and fabricate a mechanism that can extract fibre from pineapple leaf. Besides that, testing and analyze of pineapple leaf fibre extraction machine based on the different speed of motor using knife scraper roller with the help of vise grip to extract the leaf.

CHAPTER 2
LITERATURE REVIEW

2.1 Natural Fibre

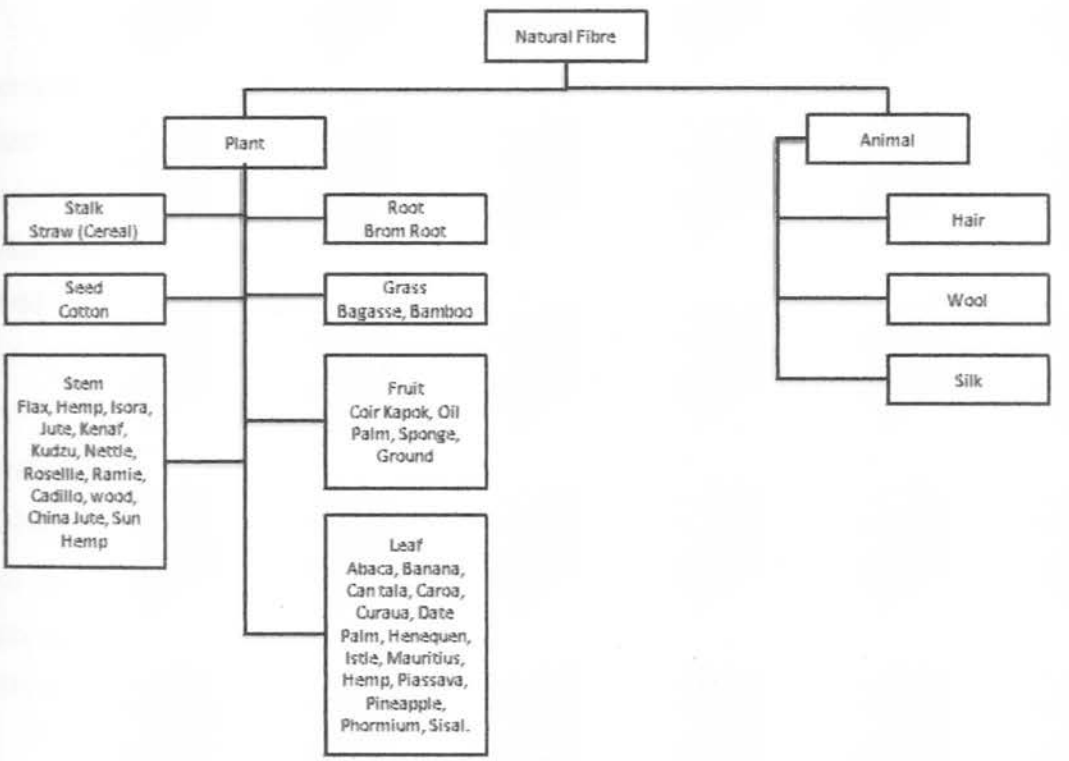

Figure 2.1: Subdivision of natural fibre based on origin (Azwa et al., 2013).

Plant and animal are the base of natural fibre. Hair, silk or wool are composed of protein in animal fibre. The stem or soft sclerenchyma (bast fibre), leaf seed, fruit, wood or cereal straw are extract from plant fibre. From the Figure 2.1 show that kind of natural fibre based on their source (Azwa et al., 2013).

The factor in performance of natural fibre such as fibre extraction, age of plant, fibre extraction process and others. The method of fibre bundles extract from bast stem and leaf while seed fibre like cotton lint extracted from ginning process. Another one method, for strip fibre bundle will using decorticator technique for extracted stem and leaf. After that it will be the retting technique that have dry retting or water retting which is use chemicals and biological treatment. Europe most popular dew retting but not good enough than water retting. Asian countries that is use water retting (Asim et al., 2015).

2.2 Pineapple

The second harvest of profit after bananas is a pineapple which is contributing to over 20 % of the world production of tropical fruits. Pineapple fruit class of the Ananas genera and the Bromelieaceae family for example Ananas bracteatus, Ananas fritzmuelleri, Ananas erectifolia and Aananas ananasioides, which make very small and roughly seedless fruit (J. De La Cruz Medina et al., 2001).

The first written documents of some varieties of pineapple was De Oviedo working in Spanish government officer when came to America in 1513 with several Indies varieties. Their give name by "pineapple" because of fruit look like pine cone but another native called "anana" meanings that "excellent fruit" sources from "ananas" (Asim et al., 2015). From that can see many languages or words from different native.

The family Bromeliaceae had 2794 species and 56 genera of custom made to large range of habitats. From wet to very dry environment and changing altitudes from sea level to alpine surroundings that can grow up be a pineapple. End of the 17th century, on the island of Hispaniola part of Antilles (West Indies) sited between Cuba to the west and Puerto Rico to the east by Charles Plumier which cultivated the pineapple (A.Govert., 2008).

2.2.1 Characteristic of pineapple

Altitudes below 800 meter above sea level commonly restricted in pineapple manufacture even though Kenya positioned between 1400 meter and 1800 meter and Malaysia orchards as high as 2400 meter. Actually, when altitudes larger than 1000 meter smaller fruit of pineapple are created which is the pulp has less attractive colour and taste. The best possible growth temperature lies between 20 to 30°C, and more particularly at 23 to 24°C. But when temperature drops between 10 to 16°C fruit growth unnatural which is plants might rise sub-freezing temperatures for very short periods. On the other hand, coverage to temperatures well over 30 °C heat damage may happen due to enlarged respiration rate and metabolism and less nutrient combination (J. De La Cruz Medina et al., 2001).

The produce of the flowering based on the pineapple fruit showing in Figure 2.2 Developed new circulation material (stem shoots, suckers, slips) is previous to the maturation of the first fruit the plant. Sprouting of almost 50 to more than 200 being flowers depending on the cultivar. The flowers are hermaphrodites and at the last part of the flowers a crown containing 150 leaves is establish. It is likely to make flowering by exterior means. The cultivar and the climate of the growing region based on the time from culturing to harvest. Production sites near the Equator may need 12 months, whereas in sub-tropical areas, this phase may extend for up to 36 months (J. De La Cruz Medina et al., 2001).

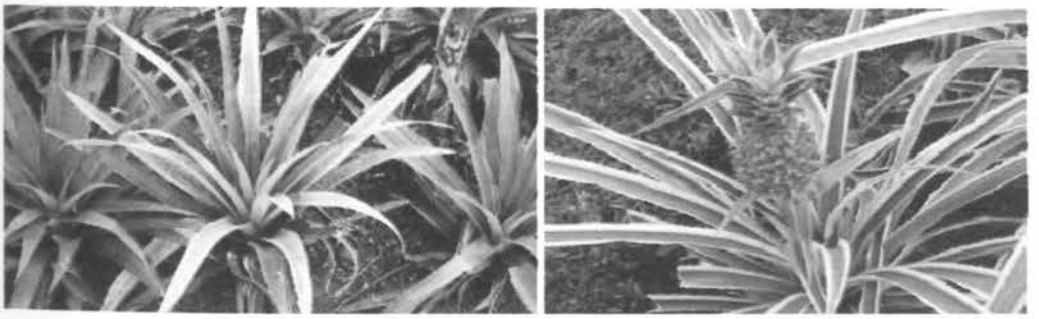

Figure 2.2 : Pineapple leaves and typical pineapple flower (J. De La Cruz Medina et al., 2001).

2.2.2 Pineapple leaf

Some of explanation based on characteristic of pineapple leaf that have shape look likes sword that taper at the top with green and black colours. There are also sharp thorns on the edge of leaf. In involving leaf 55 cm to 75 cm length by 3.1 cm to 5.3 cm wide and 0.18 cm thick leaves of up to 0.27 cm which is depending on the species kind of plant in pineapple. Besides that, class of pineapple, spacing and sharing of sunlight have an effect on the growth length of leaves and potency in resulting fibre. Giving out the sunlight in not too a large amount (partially unseen) usually generate a strong fibre, refined and like to silk (Adam & Yusof., 2015).

In Malaysia, the kind of Josapine mostly collect pineapple leave at Pontian, Johor. It is because Josapine the most excellent fibres in expression of fineness, mechanical properties, and thermal stability. Fresh leaves collected after harvesting were directly extracted within three days in order to good quality fibres (Yusof et al., 2014). Figure 2.3 is a picture of Josapine (Mohamed et al., 2009).

Figure 2.3: Josapine Pineapple (Mohamed et al., 2009)

2.3 Pineapple Leaf Fibre

2.3.1 Feature of pineapple leaf fibre

As green composite materials becoming an main investigate based on biodegradable Fibre Reinforce Polymer (FRP). The huge possible to be used as

reinforcing materials in green composite produce which is pineapple leaf fibre as one of the natural fibre. In the FRP the more attractive is pineapple leaf fibre, and mechanical properties are show in Table 2.1 of properties of pineapple leaf fibre according to Kasim *et al.*, (2015) states that in Malaysia the pineapple production is saleable. However, only the fruit is used while the leaf, which contains fibre, is usually burned or thrown away. So that can recycle leaf from wastage to develop of industry.

Table 2.1: Properties of pineapple leaf fibre (Kasim et al. 2015).

PROPERTY	VALUE
Density (g/cm^3)	1.526
Softening Point (^oC)	104
Tensile Strength (MPa)	170
Young's Modulus (MPa)	6260
Specific Modulus (MPa)	4070
Elongation at Break (%)	3
Moisture regain (%)	12

2.3.2 Use of Pineapple Leaf Fibre

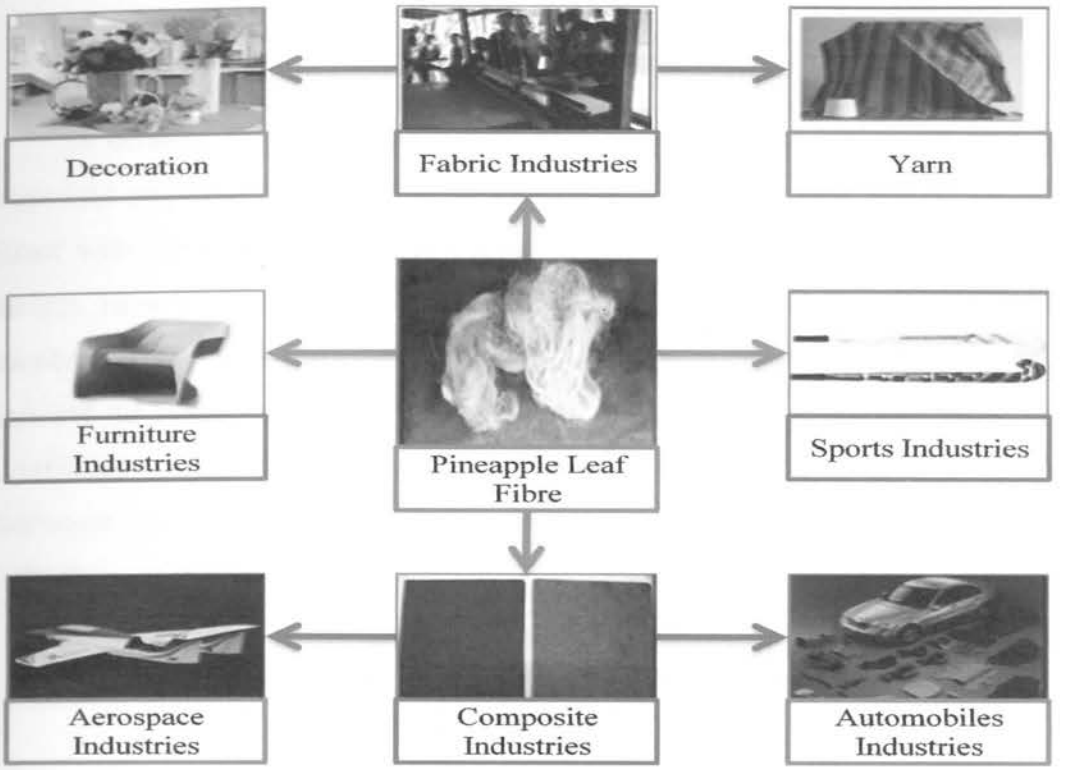

Figure 2.4 Various present and future applications of pineapple leaves (Asim et al., 2015).

Economic, eco-friendly, and recyclable are use of pineapple leaf fibre in composite material is a new foundation of materials. These properties are suitable for its purpose as building and construction materials, automotive components, and furniture. Pineapple leaf fibre is extensively received in textile sector and already used in daily life equipment but qualified that further study will improve its appliance in improvement a variety of goods. Figure 2.4 perform various present and future applications of pineapple leaves accordingly to (Asim et al., 2015) which is industry can built more working area on this application to development country.