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# Comparative Study on the Physical Quality of Paper Produced From Cogon Grass *(Imperata cylindrica)* and Rice Stalk *(Oryza sativa)*

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## ABSTRACT

This study aimed to determine the difference of paper production from rice straw (Oryza sativa) and cogon grass (Imperata cylindrica), two types of grass. The researchers compared the characteristics of the produced paper and determined which of the two materials was more efficient to use. The rice straw and the cogon grass were boiled and crushed to extract the pulp. The samples that were produced were then tested and analyzed. The paper pulp of both grass species were compared in terms of their firmness, oil retention, and water retention. T-test was used to analyze the gathered data. Results showed that there was no significant difference in the breaking strength, oil retention and water retention of the paper produced from cogon grass and rice stalk.

# Comparative Study on the Physical Quality of Paper Produced From Cogon Grass *(Imperata cylindrica)* And Rice Stalk *(Oryza sativa)*

## Chapter 1

## Introduction to the study

### Background of the study

Paper has been traced from China in about AD 105. It eventually reached central Asia 751 AD. By the 14th century, paper mills were introduced in several places in Europe (Britannica, 1993). The invention of the printing press in 1450 increased the demand of paper. In the 19th century woods and grass were used to replace rags for paper production.

Nowadays our planet faces the problem of waste products produced all throughout the world. Waste comes in different form, gaseous, solid and liquid. There are two kinds of waste, biodegradable and non-biodegradable. Non-biodegradable waste is a major part of the problem. Not capable of decomposing naturally, a non-biodegradable material takes longer time to turn into biodegradable waste-substances capable of natural decomposition into harmless elements in a short period of time (New Webster's Dictionary & Thesaurus of the English Language). Examples of these materials are plastics and Styrofoam, which we often use. So to reduce our concerns with the non-biodegradable

waste, we should try to substitute materials such as paper to other materials composed of plastic and Styrofoam. Being biodegradable, it is easily decomposed by the soil. Paper, which is mainly made out of trees, is easy to produce, and much cheaper than any other non-biodegradable materials. But the demand of paper product is also increasing making it more difficult to cope with the peoples' needs. Therefore the paper manufacturers cut down more trees to be processed into paper.

This action threatens the trees of our forests, which is one of our country's problems. To lessen our concerns researchers tried to find materials, which would serve as a substitute for trees, used to make paper.

Research studies were able to conclude that the feasibility of cogon grass and rice straw could be used as a substitute to produce paper. Researchers from Philippine Science High School Quezon City were able to produce paper out of this Cogon grass (Bato Balani, Vol. 15, 1995-96). The researchers of that study were able to produce paper out of those products. Since cogon and rice straws are economical and environment friendly materials they are suitable substitute for trees. Both materials could be made into pulp, which we may use to transform into paper. In this research study, the researchers would try to evaluate and compare the characteristics and the quality of the outcome of the grass pulp.

The relationship between variables in this study is represented in Figure 1.

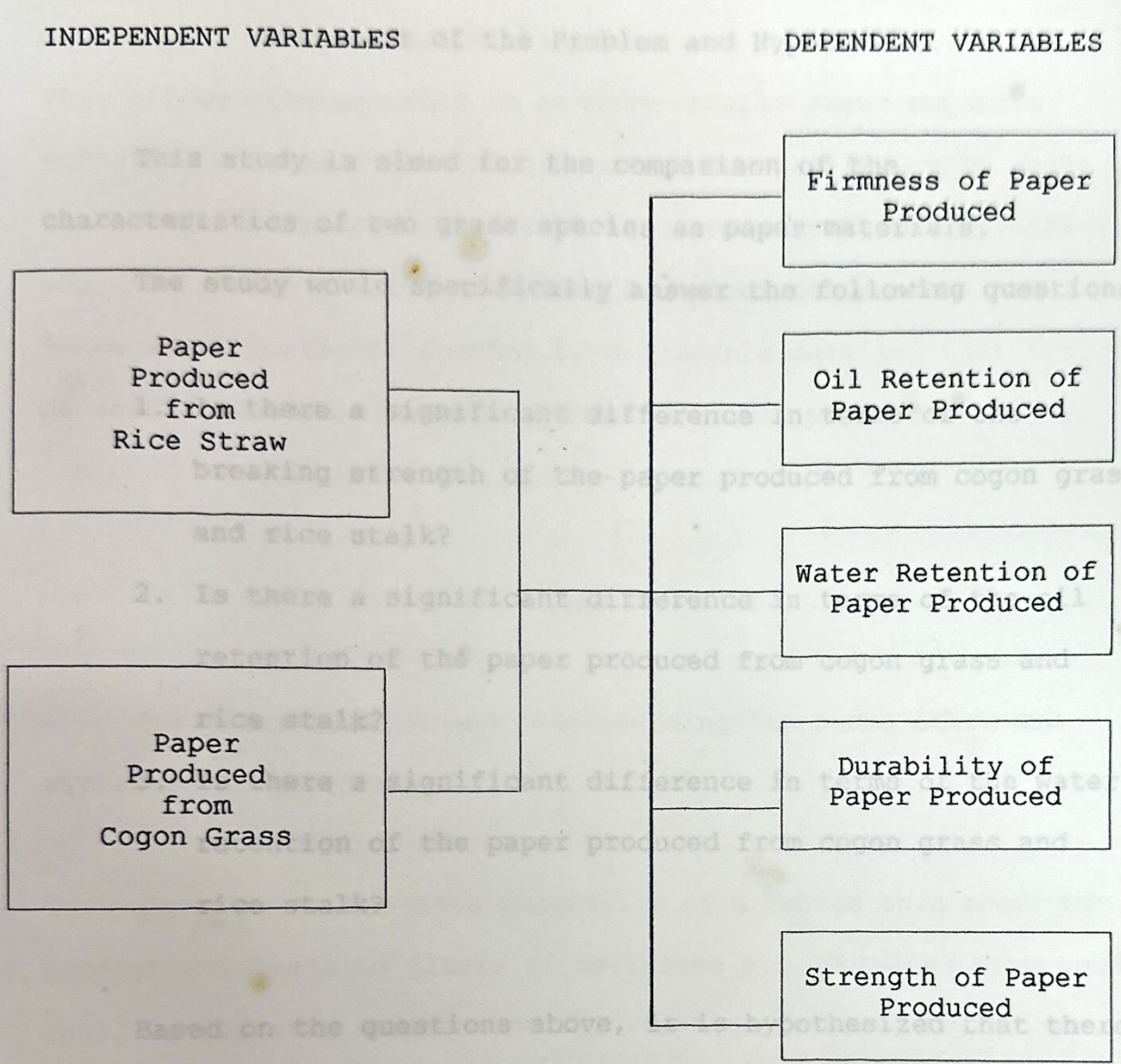


Figure 1. Firmness, oil retention, water retention, strength and durability of paper produced from rice straw and cogon grass.

## Statement of the Problem and Hypothesis

This study is aimed for the comparison of the characteristics of two grass species as paper materials.

The study would specifically answer the following questions:

1. Is there a significant difference in terms of the breaking strength of the paper produced from cogon grass and rice stalk?
2. Is there a significant difference in terms of the oil retention of the paper produced from cogon grass and rice stalk?
3. Is there a significant difference in terms of the water retention of the paper produced from cogon grass and rice stalk?

Based on the questions above, it is hypothesized that there would be no significant difference in terms of firmness, oil retention, and water retention and in other economic aspects.

## Significance of the study

This study allows paper manufacturers to select an appropriate substitute for trees as source for paper pulp. This lessens the cutting down of trees and save our country's forest. This allows researchers to choose more economical and more

environment friendly materials to be used in our daily needs. This allows manufacturers to produce cheaper paper products. Using products made from paper lessens our problems with waste. Since cogon grass and rice stalks are abundant in many places it would be easier to find materials for paper production. This shows the importance of other biodegradable material that could be used as source of paper to our economical problems.

## Definition of Terms

For clarification and understanding the terms below are explained conceptually:

Paper - a substance consisting of a felted thin sheet of compactly interlaced fibers of cellulose etc. Obtained from wood, rags, straw, etc. And is used for writing, covering rooms, etc. (Webster, 1995).

In this study, the term "paper," refers to the product produced from rice straw, and cogon grass.

Paper pulp - raw material for paper manufacturing that contains vegetable, mineral or man-made fibers. It forms on a matted or felted sheet on a screen when moisture is removed (Miller, 1997).

In this study, the term "paper pulp" would mean as defined.

Rice stalks - an annual cereal grass widely cultivated for its seed used for human food. It is one of the world's most important food crops. Rice is grown in Asian countries, especially in China and India. In Asia, dried rice stalks are used to make paper, sandals, hats, etc. Fermented rice kernels are used for wine making (Webster, 1995).

In this study, "rice straw" would be used as the independent variable.

Cogon grass - one of the about seven species of perennial constituting the genus Zmperata (family Piaceae). A tall grass native to the western North America has a thin silvery flower cluster. Each spikelet bears many long silky hairs (Bellen, Dasa, 1999).

In this study, "cogon grass" would be used as the independent variable.

# Chapter 2

## Review of Related Literature

Nicholas-Lois Robert created the first paper machine. He used a moving screen belt; paper was made one sheet at a time by dipping a frame or mold into a vat of pulp. John Dickinson improved this machine and called it the cylindrical machine.

Most of the process in making paper was highly mechanized; the basic process still remains today. This is done by separating the fibers from woods, grass, stalks, and other materials and then wetted to produce paper pulp, also known as stock. The pulp is then filtered on a woven screen to form a sheet of fiber, which is pressed and compacted to squeeze most of the water. The remaining water is removed by evaporation. The dry sheet is further compressed depending upon the intended use (Webster, 1993).

Types and grade of paper are determined by several factors: the type of fiber used; the preparation of the pulp either by mechanical or chemical method or by the combination of the two; by addition of any other materials to the pulp; by conditions under the sheet was formed; and by the chemical and physical treatment applied on the finished sheet.

Wood which is the major source of fiber is not the only material were we could also extract fiber, we could extract them from grass stalks, rags and other fibrous biodegradable material such as baggase, esparto, bamboo, flax and jute. But some papers are made from synthetic fiber.

Rice is a staple crop in this country, but the straw has not been utilized extensively. It is used in small quantities for mulch, animal feeds, as a medium for growing mushrooms, fuel, mattresses and other minor products, but in general, it is left in the fields after harvest and burned when the land is prepared for planting. Recently, however, attention has been focused on this material as a source of fiber for papermaking. Three companies, to be located in Nueva Ecija, Bataan and Iloilo have been registered or have applied for registration, as pioneering industry, with Board of Investments (NSTA Technology Journal, Jan-Mar 1984).

Rice straw is a well-known material for pulp and papermaking. It is used in many Asian countries, notably in Korea and China for production of fine print papers (NSTA Technology Journal, Jan-Mar 1984).

Paper is measured in terms of reams and could be measured by caliper and density. The strength and durability of paper is determined by factors such as length and strength of the fibers plus their bonding abilities, the formation and the structure of the sheet (Britannica, 1993).

# Chapter 3

## Research Design and Methodology

The researchers conducted this study to analyze and compare the paper production from two species of grass, rice (Oryza sativa) and Cogon grass (Imperata cylindrica).

The researchers of this study hypothesized that there would be no significant difference in the breaking strength, oil retention and water retention existing on the paper produced from cogon grass and rice stalk.

### Methods

#### Gathering and Preparations

The Cogon grass and the rice stalk were cut separately in 0.5 inches strips, with the help of scissors. Then the Cogon and rice stalks were washed in water to remove unwanted materials and wastes separately.

#### Pulping

The Cogon strips and rice stalk strips were boiled in two separate clay pots. The clay pots contain 1.5 liter of water plus 50 ml of caustic soda. The mixture was left to boil for about 20 to 30 minutes in medium heat.

Washing and Bleaching

The mixtures were then removed from the fire and washed under running water. After this was done, the cogon and rice stalks were placed in two basins. The basins contained the same amount of water and same amount of liquid bleach.

Crushing and Filtering

The Cogon and Rice stalk pulps were removed from the basins the after the mixtures of water and liquid bleached. After this was done the Cogon and Rice stalks were crushed with a mortar and pestle. Then after the Cogon and Rice stalk were crushed we removed any unwanted materials that could be found on the pulp. A thin cloth was used to remove and filter any unwanted material to yield a purified pulp. The pulps of both species are then put inside an absorbent cloth then squeezed with a rolling pin. This was done to extract excess water.

Sheet Forming

The pulps were placed in two different basins that contained five liters of water, 30 grams of resin and powdered alum. Using the mold and deckle we formed the sheet. Then it was left to dry out in the sun.

Testing

Paper produced from cogon grass and rice stalk was cut using scissors into similar sizes. The samples were then labeled and pre-weighed. Samples with nearly the same weight were paired and were subjected to the tests.

### Breaking Test

Two researches held the sample on both sides and another researcher placed peso coins on top of it until it broke.

### Water Retention

The pre-weighed samples were soaked in a basin full of water for five minutes. Then the researchers removed the excess water and weighed the sample to find out how much water did each sample absorb. By subtracting the weight of the pre-weighed sample from the weighed of the sample after it was soaked in water, the researchers were able to find out the water retention of the samples.

### Oil Retention

The pre-weighed samples were soaked in a basin full of cooking oil for five minutes. Then the researchers removed the excess water and weighed the sample to find out how much water did each sample absorb. By subtracting the weight of the pre-weighed sample from the weighed of the sample after it was soaked in oil, the researchers were able to find out the oil retention of the samples.

## Data Analysis

A t-test compares the means of two groups. The t-test was used as inferential tool.

### T-test

The one way T-test was used to determine the significant difference between the breaking strength, oil retention, water retention, of the paper produced from cogon grass and rice stalk.

# Chapter 4

## Results and Discussions

### Breaking Strength

The paper made from cogon grass was able to hold 138 pieces of one-peso coins. Each peso coin weighed 6 grams. Breaking strength of the paper made from Cogon grass was 828 grams.

The paper made from rice stalk was able to hold 123 pieces of one-peso coins. Each peso coin weighed 6 grams. Breaking strength of the paper made from Cogon grass was 738 grams.

### Water Retention

The water retention test was done three times. Paper made from cogon grass and rice stalk must almost weigh the same.

First sample of paper made from cogon grass and rice Stalk pre-weighed 11.25 grams and 11.3 grams respectively. After the test the paper from the first sample of cogon grass and rice stalk weighed 22.3 grams and 35.7 grams respectively. Based on the first test the water retention of paper made from rice stalk was higher than that of the paper made from cogon grass by 13.4 grams.

Second sample of paper made from cogon grass and rice stalk pre-weighed 9.05 grams and 9.02 grams respectively. After the test the paper from the first sample of Cogon grass and rice stalk weighed 19.9 grams and 30 grams respectively. Based on the second test the water retention of paper made from rice stalk was

higher than that of the paper made from cogon grass by 13.4 grams.

Third and the last sample of paper made from cogon grass and rice stalk pre-weighed 12.7 grams. After the test the paper from the first sample of cogon grass and rice stalk weighed 16.3 grams and 33.3 grams respectively. Based on the third test the water retention of paper made from rice stalk was higher than that of the paper made from cogon grass by 17 grams.

According to the unpaired t-test results by GraphPad.com, there was a very statistically significant difference in the water retention of paper produced from cogon grass and rice stalk. The two-tailed P value was equal to 0.0049.

Oil Retention

The oil retention test was done three times. Paper made from cogon grass and rice stalk must almost weigh the same.

First sample of paper made from cogon grass and rice stalk pre-weighed 2.02 grams and 2.03 grams respectively. After the test the paper from the first sample of cogon grass and rice stalk weighed 9.9 grams and 12.22 grams respectively. Based on the first test the water retention of paper made from rice stalk was higher than that of the paper made from cogon grass by 2.32 grams.

Second sample of paper made from cogon grass and rice stalk pre-weighed 1.87 grams and 1.85 grams respectively. After the test the paper from the first sample of cogon grass and rice stalk weighed 9.4 grams and 10.5 grams respectively. Based on

the second test the water retention of paper made from rice stalk was higher than that of the paper made from cogon grass by 1.1 grams.

Third and the last sample of paper made from cogon grass and rice stalk pre-weighed 1.6 grams and 1.61 grams respectively. After the test the paper from the first sample of cogon grass and rice stalk weighed 6.92 grams and 8.17 grams respectively. Based on the third test the water retention of paper made from rice stalk was higher than that of the paper made from cogon grass by 1.25 grams.

According to the unpaired t-test results by GraphPad.com, there was no significant difference in the oil retention of paper produced from cogon grass and rice stalk. The two-tailed P value was equal to 0.3557.

# Water Retention

**Test Results**

| SAMPLE | *PAPER FROM:* → | Cogon Grass | Rice Stalk |
|---|---|---|---|
| Sample 1 | Initial Weight | 11.25 g | 11.3 g |
| | Final Weight | 22.3 g | 35.7 g |
| Sample 2 | Initial Weight | 9.05 g | 9.02 g |
| | Final Weight | 19.9 g | 30.0 g |
| Sample 3 | Initial Weight | 12.7 g | 12.7 g |
| | Final Weight | 16.3 g | 33.3 g |

**Unpaired t test results**

P value and statistical significance:

The two-tailed P value equals 0.0049

By conventional criteria, this difference is considered to be very statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -13.500

95% confidence interval of this difference: From -20.169 to -6.831

Intermediate values used in calculations:

t = 5.6201

df = 4

standard error of difference = 2.402

Review of data:

| Group | Group One | Group Two |
|---|---|---|
| Mean | 19.500 | 33.000 |
| SD | 3.020 | 2.862 |
| SEM | 1.744 | 1.652 |
| N | 3 | 3 |

by: GraphPad.com

## Oil Retention

**Test Results**

| SAMPLE | *PAPER FROM:* → | Cogon Grass | Rice Stalk |
|---|---|---|---|
| Sample 1 | Initial Weight | 2.02 g | 2.03 g |
| | Final Weight | 9.9 g | 12.22 g |
| Sample 2 | Initial Weight | 1.87 g | 1.85 g |
| | Final Weight | 9.4 g | 10.5 g |
| Sample 3 | Initial Weight | 1.6 g | 1.61 g |
| | Final Weight | 6.92 g | 8.17 g |

**Unpaired t test results**

P value and statistical significance:

The two-tailed P value equals 0.3557

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -1.5567

95% confidence interval of this difference: From -5.6992 to 2.5859

Intermediate values used in calculations:

t = 1.0433

df = 4

standard error of difference = 1.492

Review of data:

| Group | Group One | Group Two |
|---|---|---|
| Mean | 8.7400 | 10.2967 |
| SD | 1.5959 | 2.0326 |
| SEM | 0.9214 | 1.1735 |
| N | 3 | 3 |

*by: GraphPad.com*

# Chapter 5

## Recommendations and Conclusions

### Conclusion

Results show that there is no significant difference in breaking strength, and oil retention of paper produced from cogon grass and rice stalk and that there is very significant difference in the water retention of paper produced from cogon grass and rice stalk.

The researchers concluded that there is no significant difference on the quality of paper produced from cogon grass and rice stalk.

### Recommendation

We recommend further research on the quality of paper that was produced from cogon grass and rice stalk. Other research studies may focus on the market acceptability on the paper produced from cogon grass and rice stalk.

Future researches could focus on papers, which could have similar characteristics with commercial papers, like intermediate pad paper, typewriting paper, book papers, etc. Others could make thick papers that could be used for packaging.

Maybe, if possible future researches could research on other materials that could be used in producing paper as substitute for wood.

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