

**An Investigation Into Sustainable Paper Alternatives for the UBC Campus (Sugar Cane
Versus Wheat Waste Fibre)**

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University of British Columbia

APSC 262

April 4, 2013

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An Investigation Into Sustainable Paper Alternatives for the UBC Campus (Sugar Cane Versus Wheat Waste Fibre)

Applied Science 262 - Sustainability Project

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Submission Date: April. 4th, 2013

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ABSTRACT

The University of British Columbia has an initiative to come up with a viable paper alternative on campus to support their goal of sustainable development. This report will discuss the results of a triple bottom line assessment that compares the economic, environmental and social aspects of two paper alternatives made from sugar cane and wheat waste fibres. The sugar cane paper is manufactured in Columbia by a company called TreeZERO and is 100 percent tree free. The wheat waste paper is manufactured in India by a company called Prairie Pulp and Paper and is composed of 80 percent wheat waste and 20 percent tree fibres. The economic life cycle of each paper alternative was investigated along with the potential economic benefits associated with manufacturing each paper alternative in Canada. The carbon footprint associated with the processing, transporting, and recycling of each paper alternative was considered in the environmental section of the report. Lastly, the social indicators assessed the labours laws in the manufacturing countries and the social acceptance of each paper, which was determined through surveying students at the UBC campus.

The information required to complete this assessment was obtained using scholarly peer reviewed journals and direct conversation with industry professionals. In particular, Mark Tracey, a sales representative from TreeZERO, provided the economics associated with the sugar cane paper.

The results of the triple bottom line assessment showed that the sugar cane paper was the more sustainable paper source. The economic analysis showed that sugar cane paper is favoured due to its 7 percent lower purchasing cost and 50 percent lower transporting costs. From an environmental standpoint, the sugar cane paper has a 23 percent lower carbon footprint than the wheat waste paper, primarily associated with the transportation required. Socially, there was a public preference for the sugar cane paper due to it being 100 percent tree free and having a lower carbon footprint. Presently, it is advised that UBC Payment and Procurement further investigates the sugar cane paper as a sustainable alternative on the UBC campus.

TABLE OF CONTENTS

ABSTRACT.....	ii
LIST OF TABLES AND FIGURES.....	iv
GLOSSARY.....	v
LIST OF ABBREVIATIONS.....	vi
1.0 INTRODUCTION.....	1
2.0 ECONOMICS.....	2
2.1 ECONOMIC LIFE CYCLE.....	2
2.2 CANADIAN MANUFACTURING.....	3
3.0 ENVIRONMENTAL.....	5
3.1 ENVIRONMENTAL LIFE CYCLE.....	5
3.2 CANADIAN MANUFACTURING.....	7
4.0 SOCIAL.....	9
4.1 LABOUR LAWS.....	9
4.2 PUBLIC ACCEPTANCE.....	9
5.0 CONCLUSION AND RECOMMENDATION.....	11
REFERENCES.....	12
APPENDIX.....	15

LIST OF TABLES AND FIGURES

Figure 1: Shipping Distances from manufacturing facility to UBC campus

Figure 2: Transportation route for sugar cane paper from Colombia

Figure 3: Transportation route for wheat waste paper from India

Figure 4: Transportation route for wheat waste paper from Saskatchewan

Figure 5: Summary of carbon footprint per 5000 sheets of paper

Table 1: Summary of Paper Properties

GLOSSARY

Bagasse	The fibrous material that remains after the sugar cane is removed from the stalk
Retrofit	To implement new components and equipment into an existing facility
Carbon Footprint	The amount of greenhouse gas emissions caused by a particular event or organization
Grammage	A measure of weight per unit area of paper
Opacity	The degree of light that is restricted from travelling through paper
Stiffness CD	The measure of the force required to bend the sheet in the cross directional orientation of the paper machine flow
Stiffness MD	The measure of the force required to bend the sheet in the same orientation of the paper machine flow
Wheat Straw	The by-product stalk of wheat after the grain and chaff have been removed

LIST OF ABBREVIATIONS

UBC	University of British Columbia
CO ₂	Carbon Dioxide
kg	Kilogram
km	Kilometer
kg _{CO2}	Equivalent CO ₂ Weight in Kilograms
m ²	Area measured in meters

1.0 INTRODUCTION

The University of British Columbia is a leader in sustainable development, taking on numerous initiatives to bring together education, research, operations and partnerships. One of UBC's initiatives is to one day become a paperless institution; however, it is inevitable that paper is going to be a common commodity on campus for the near future. To account for this, the Payment and Procurement Services at UBC has set out to find the most sustainable paper source alternative. Paula Goldspink, from UBC's Supply Management, has narrowed down the potential alternatives to paper made from wheat waste fibre or sugarcane fibre (bagasse). The wheat waste paper consists of 80% wheat waste fibre and 20% tree fibre, and is produced by a Canadian company called Step Forward Paper. This paper is currently being manufactured in India, but there are aspirations for it to be manufactured in Canada by 2015. The sugar cane paper is made from 100% sugar cane fibre, and is produced by an American company called TreeZERO Paper Company. This paper is manufactured in Columbia; however, unlike the wheat waste fibre paper, there is no possibility of sugar cane paper to be manufacture in Canada. This report will conduct a triple bottom line assessment to compare the environmental, economic and social impacts associated with paper made from wheat waste fibre and sugar cane fibre.

2.0 ECONOMICS

In order to assess the economic feasibility of each paper source, two main indicators had to be considered. First the economic life cycle for each paper source will be investigated to examine the costs associated with the purchasing, processing, transporting and recycling each product. Next, the possibility of manufacturing each paper source in Canada will be explored to determine the benefits for both the local economy and the end users.

2.1 ECONOMIC LIFE CYCLE

For the economic life cycle analysis, the purchasing costs, processing costs, transporting costs and recycling costs were examined for each paper alternative. The first factor that was considered was the cost to purchase a case of 5000 sheets of each paper. The Step Forward wheat waste paper is available at both Grand and Toy and Staples office supply retailers and has a cost of \$59.99 for a case of 5000 sheets; however, this is the advertised price for the general public which is higher than what UBC would pay. In regards to the sugar cane paper, TreeZERO has only made their product available through direct purchase rather than through third party retailers. Mark Tracey, a sale representative from TreeZERO, quoted a price of \$56.00 for a 5000 sheet case of their sugar cane paper product. Two major considerations were examined to determine why the wheat waste paper is more expensive. First, the costs associate with the manufacturing of the paper source alternatives were considered. It was determined that the cost to manufacture the wheat waste paper was two percent lower than the cost to manufacture the sugar cane paper (Jacobs, 1997). This two percent difference in manufacturing cost was essentially negligible as it is offset by the large difference in transportation costs for each product. The wheat waste paper has to be shipped from India, travelling a distance of approximately 18,270 kilometers. This travelling distance is substantially higher than the 9,130 kilometers required for the sugar cane paper to be shipped from Columbia (Pier2Pier, 2004). The possibility of manufacturing wheat waste paper in Canada will have a large impact on the transportation cost, which will be investigated in the next section of the report. Lastly, being that both the wheat waste and sugar cane papers can

be recycled using the conventional methods in facilities for wood fibre paper, the costs are relatively the same and do impact the economic analysis (Barsness, 2007).

2.2 CANADIAN MANUFACTURING

The ability to manufacture each type of paper in Canada was explored to determine the economic benefit. It was determined that only the wheat waste paper can be produced in Canada, and that the sugar cane paper could not due to the required climate. Being that wheat waste paper has the potential to be manufacture locally presents many benefits to both Canada's economy and the consumer of the paper. Manufacturing the wheat waste paper in Canada would reduce the countries unemployment rate and increases the tax revenue. In addition, as the demand increases for wheat waste paper, the cost of other wheat based products will decrease. This is due to the fact that the wheat waste paper is purely made from wheat straw, and there would be an abundance of usable wheat if the demand for the wheat paper grows. The primary concern with manufacturing the wheat waste paper in Canada is the large capital investment required to retrofit the existing facilities. This capital cost can be justified by the large decrease in the shipping cost due to the reduction in travel distance and international taxes. The following figure displays the potential economic benefit associated with reduced shipping distances if the wheat waste paper were to be produced in Canada:

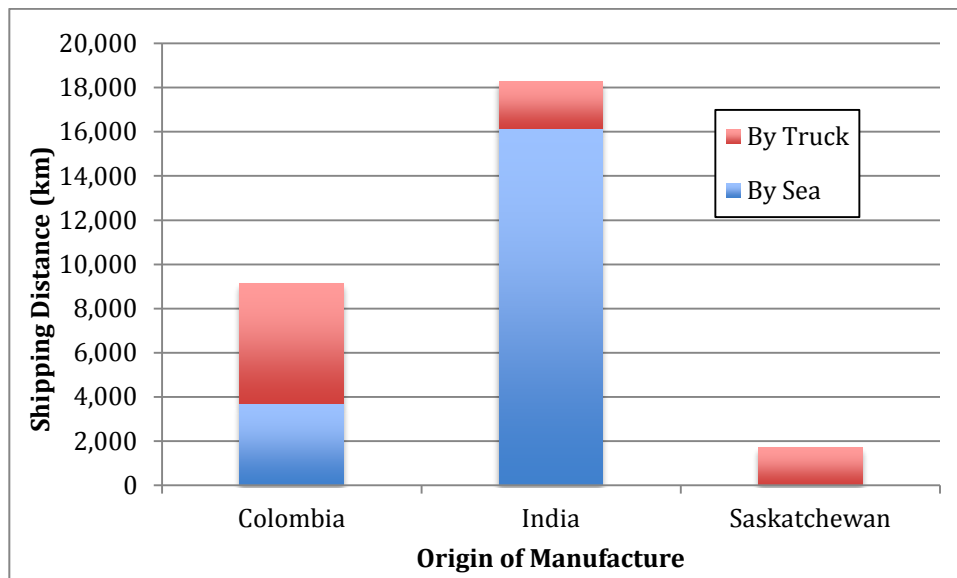


Figure 1: Shipping Distances from Manufacturing Facility to UBC Campus

Source: < <http://www.pier2pier.com/Co2/> >

It can be seen that there is a substantial decrease in the shipping distance if the wheat waste paper was to be produced in Canada. Manufacturing the wheat waste paper in Canada would decrease the shipping distance by approximately 90 percent. Also, the paper product would be shipped via rail from Saskatchewan, rather than by boat from India. As rail is the least expense method for shipping, this would result in overall product cost.

3.0 ENVIRONMENTAL

In order to determine the environmental impacts associated with each of the paper alternatives, a life cycle analysis was performed to determine the carbon footprint related to the processing, transporting and recycling of each paper.

3.1 ENVIRONMENTAL LIFE CYCLE

The difference in environmental life cycles with respect to carbon dioxide emissions is strongly correlated to the transportation distances of each type of paper. The difference in energy consumption during the processing of both paper alternatives is relatively negligible. Overall, the wheat waste paper process requires approximately two percent less energy than the process used to produce the sugar cane paper. Similarly, both alternative paper sources are recycled using conventional methods; therefore, the energy used to recycle both the wheat waste paper and sugar cane paper are approximately equal. To address the carbon footprint associated with the transportation of each alternative paper source, the total distances along with the mode of transportation was investigated. Using the grammage and the area of a letter size sheet of paper, the weights of a 5000 sheet case for both types of paper were calculated as shown in the Appendix. Using the weights of 5000 sheets of each paper, the carbon footprint was calculated based on the distances travelled and the mode of transportation. The average carbon footprint per 5000 sheets was calculated using 3.5×10^{-4} kgCO₂/ km and 9.0×10^{-4} kgCO₂/ km for shipping by sea and truck respectively. The following two figures illustrate the transportation routes required for each paper as well as the mode of transportation:

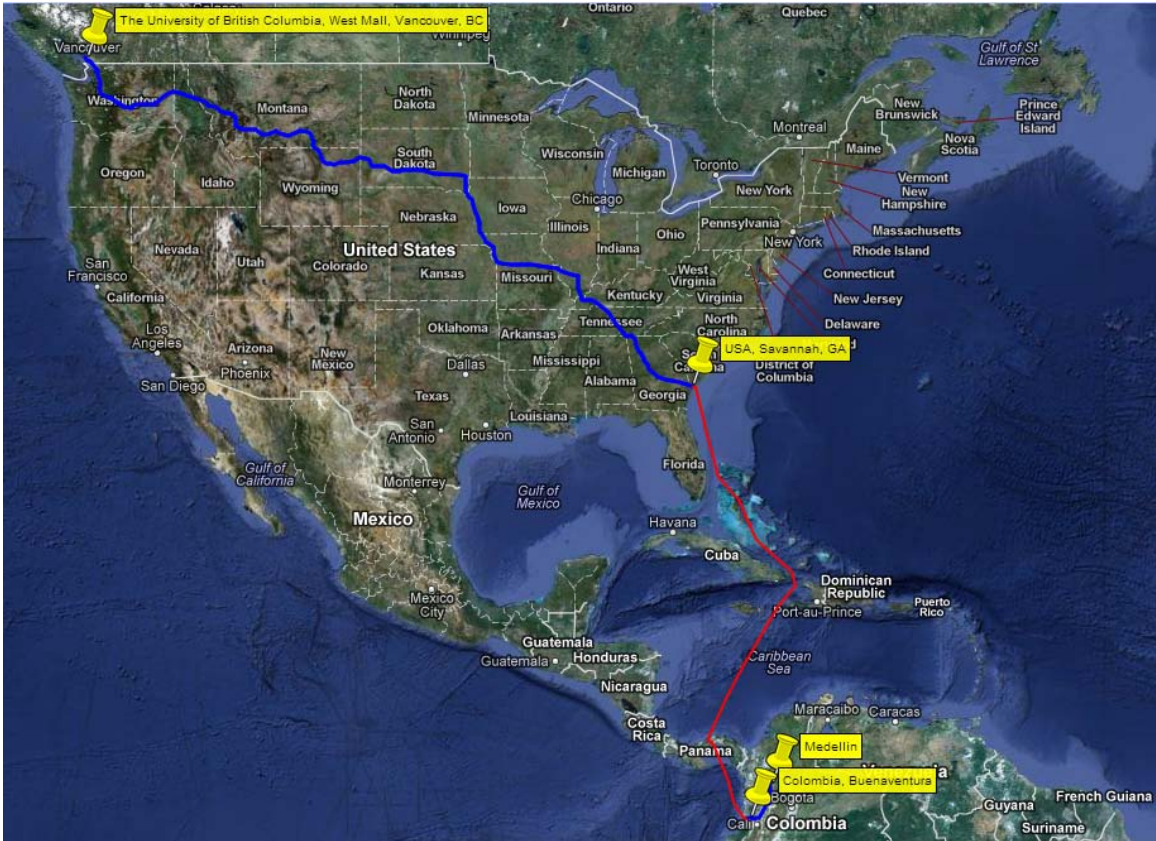


Figure 2: Transportation route for sugar cane paper from Colombia
 Source: < <http://www.pier2pier.com/Co2/> >



Figure 3: Transportation route for wheat waste paper from India
 Source: < <http://www.pier2pier.com/Co2/> >

The total carbon footprint for sugar cane paper is 6 kg_{CO2}/5000 sheets, which is made up of 1.3 kg_{CO2}/5000 sheets and 4.7 kg_{CO2}/5000 sheets from shipping by sea and truck respectively. The total carbon footprint for wheat waste paper is 7.8 kg_{CO2}/5000 sheets, which is made up of 5.8 kg_{CO2}/5000 sheets and 2 kg_{CO2}/5000 sheets from shipping by sea and truck respectively. The sugar cane paper has 23% lower CO₂ emissions than wheat paper associated with the transportation.

3.2 CANADIAN MANUFACTURING

As wheat paper has the potential to be produced in Canada, the carbon footprint can be significantly reduced due to the relatively short transportation distance required. The following figure displays the potential transportation route for the wheat waste paper from Saskatchewan:

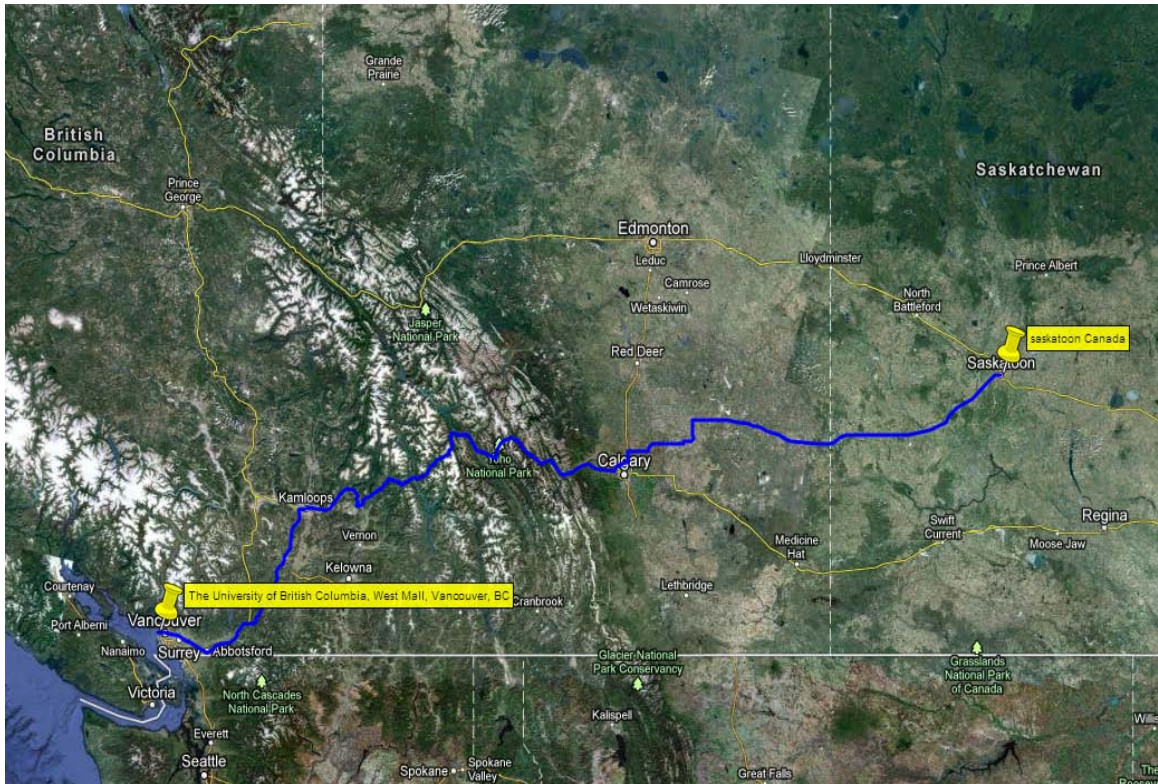


Figure 4: Transportation route for wheat waste paper from Saskatchewan
Source: < <http://www.pier2pier.com/Co2/> >

Transporting the wheat waste paper from Saskatchewan rather than India reduced the overall shipping distance by 16,580km, resulting in a 6.4 kg_{CO2}/5000 sheets lower carbon

emissions. The following figure compares the relative carbon footprints associated with transporting each paper alternative from their origin of manufacture:

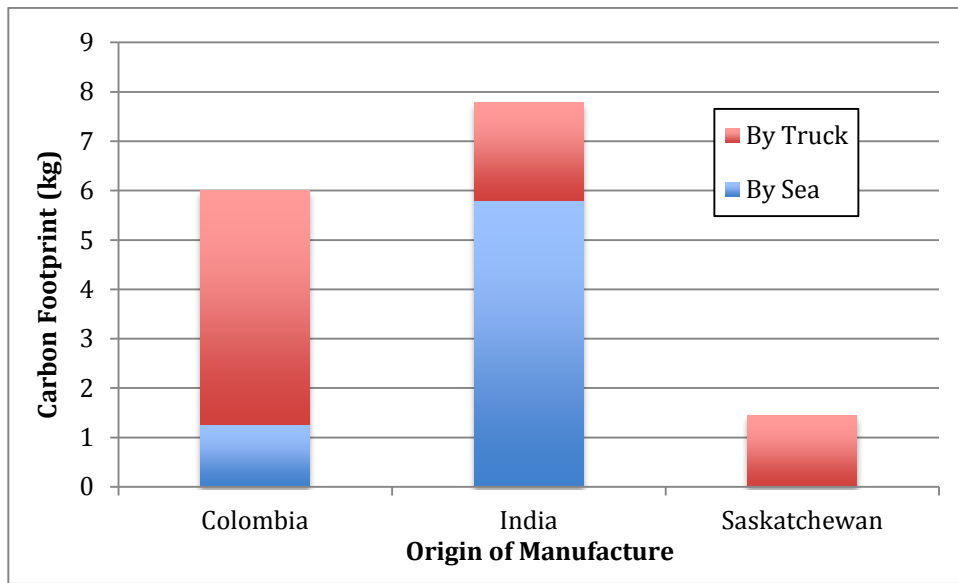


Figure 5: Summary of carbon footprint per 5000 sheets of paper
Source: < <http://www.pier2pier.com/Co2/> >

4.0 SOCIAL

For the social aspect of this assessment, two main factors were investigated. First, the labour laws in the manufacturing countries of each paper were determined along with how strictly they were enforced. Next, the public acceptance of each paper alternative was acquired by the use of a survey.

4.1 Labour Laws:

The official labour laws regulating the production of both the wheat paper and sugarcane paper comply with the acceptable standards expected in Canada and by UBC; however, it is often difficult to ensure compliance if foreign governments do not have sufficient oversight in place to enforce their own laws. With the potential for wheat paper to be manufactured in Canada, it poses advantages over sugar cane paper such that the Canadian labour laws and enforcement would protect the employees.

4.2 Public Acceptance:

A class survey was conducted which consisted of 32 students. The students were presented with a summary of the manufacturing location, paper composition, and a sample of each paper alternative. The survey asked the students to pick which of the papers they preferred from a sustainability and usability perspective. The results showed that 78 percent of the students preferred the sugar cane paper and that 22 percent of the students preferred the wheat paper. The general consensus was that the sugar cane paper was brighter, more durable, and more sustainable due to the fact that it is made from 100 percent tree free fibres. After the vote was conducted, the idea of wheat paper being 100 percent tree free and manufactured in Canada was presented. We then asked the class again which of the two paper alternatives they preferred from a sustainability standpoint. The results from the initial vote shifted and 72 percent of the student were in favour of the wheat waste paper. The primary reasons for this shift were the possibility of economic growth in Canada along with the reduction in carbon emissions due to shorter transportation distances. Based on our survey results, it can be noted that the social acceptance of the two paper sources is strongly correlated to sustainability rather than the paper quality. Knowing this, the factors associated with sustainability outweigh the paper

quality as long as they both meet the required standards. The following table displays the similarities between the quality of the two papers:

Table 1: Summary of Paper Properties

Properties	Wheat Waste Paper	Sugar Cane Paper
Brightness FS (%)	93.32	92.00
Thickness/caliper (microns)	103.00	102.00
Moisture %	4.20	6.06
Opacity %	88.43	84.00
Grammage g/m²	79.90	75.00
Stiffness CD g.cm	2.09	1.40
Stiffness MD g.cm	3.21	2.20

Source: < <http://www.treezeropaper.com/> >

Source: < <http://stepforwardpaper.com/> >

5.0 Conclusion and Recommendations

Upon completion of the triple bottom line assessment, it was determined that the sugar cane paper posed more benefits with respect to sustainability than the wheat waste paper. Economically, sugar cane paper has a 7 percent lower purchasing cost and 50 percent lower transporting costs based on shipping distances. Environmentally, both paper alternatives have similar carbon footprints associated with processing and recycling; however, the carbon footprint associated with the transportation of sugar cane paper is 23 percent lower than that of the wheat waste paper. Socially, the public prefers sugar cane paper based on the premise that it is 100 percent tree free and has slightly better quality. Currently, we advise UBC Payment and Procurement to strongly consider the sugar cane paper alternative as it shows to be more sustainable than wheat waste paper using the triple bottom line assessment. In the future, if wheat waste paper is produced in Canada and 100 percent tree free it is likely that the triple bottom line assessment would favour the wheat waste paper.

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**APPENDIX:
SAMPLE
CALCULATIONS**

Sample Calculations

Date

Determining the weight of a 5000 sheet case of paper:

Paper Dimensions: 8.5" x 11" \rightarrow 0.2159m x 0.2794m

$$\begin{aligned}\text{Area of Sheet} &= \text{Length} \times \text{Width} \\ &= (0.2794\text{m})(0.2159\text{m}) \\ &= 6.032 \times 10^{-2} \text{ m}^2\end{aligned}$$

$$\text{Grammage (Sugar Cane)} = 75.0 \text{ g/m}^2$$

$$\text{Grammage (Wheat Waste)} = 79.5 \text{ g/m}^2$$

$$\text{Weight of 5000 Sheets (Sugar Cane)} = \text{Grammage} \times \text{Area}$$

$$\text{Weight}_{,5000 \text{ sheets}} = (75.0 \text{ g/m}^2)(6.032 \times 10^{-2} \text{ m}^2)(1000\text{g/Kg})$$

$$\text{Weight}_{,5000 \text{ sheets}} = 22.62 \text{ Kg} / (5000 \text{ sheets})$$

$$\text{Weight of 5000 Sheets (Wheat Waste)} = \text{Grammage} \times \text{Area}$$

$$\text{Weight}_{,5000 \text{ sheets}} = (79.5 \text{ g/m}^2)(6.032 \times 10^{-2} \text{ m}^2)(1000\text{g/Kg})$$

$$\text{Weight}_{,5000 \text{ sheets}} = 23.97 \text{ Kg} / (5000 \text{ sheets})$$