

**Sugarcane Bagasse Paper versus Wheat Straw Paper**

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## APSC 262 - SUSTAINABILITY PROJECT



Fig.1 Images from:

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### *Sugarcane Bagasse Paper* *versus* *Wheat Straw Paper*

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## **Abstract**

Even though the usage amount of the traditional wood fiber paper has been greatly reduced by recycling or some other methods, the demand for paper is still enormous. As many global issues start to influence our daily life, people begin to pay attention to sustainable development.

In order to reduce deforestation to preserve the environment, paper manufacturers and consumers start to search for alternative raw materials for paper. As one of the leading universities that dedicate to the pursuit of sustainability, UBC initiated this project to investigate and compare the advantages and disadvantages between sugarcane bagasse paper and wheat straw paper in three main aspects. The report assesses the environmental, economical, and social impacts for both sugarcane bagasse paper and wheat straw paper. With the information we founded and compared, we suggest that UBC should purchase wheat straw paper instead of sugarcane bagasse paper because wheat straw paper is more sustainable in all environmental, economical, and social aspects.

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## 1 INTRODUCTION

Though the revolution of technology has reduced paper production everywhere around the world, the amount of paper consumed each day is still tremendously large. The main material used in paper production is wood fiber. In order to satisfy the large demand for paper, thousands of trees must be cut down every year. Deforestation caused by worldwide consumption of wood based paper has been a huge environmental issue.

As the awareness of sustainability continues to rise, the demand of sustainable paper increases. The investigation of looking for alternatives has been a critical issue. The two main alternatives on the market are wheat straw and sugarcane fiber paper.

This report will investigate both types of paper made by wheat straw and sugarcane fiber. In order to compare both types of papers in every aspect, the triple bottom line analysis will be performed. Two types of papers will be discussed and compared in three major areas: environmental, economic, and social aspects. The environmental aspect will include topics such as material used, chemicals used, carbon footprint and recyclability. The economic aspect will focus on the consumer prices of the two types of paper, the transportation costs of each paper, the impact on the economic development and job creation for the economies selling the papers, and finally the production process for each type of paper. The social aspect will include the benefits and disadvantages of wheat and sugar paper as well as an analysis of the UBC sustainability standards towards the two products.

## **2 ENVIRONMENTAL ASSESSMENT**

The environmental aspect on paper production is significant. With the modern technology, paper can be produced with more sustainable materials rather than wood fiber. Currently, paper produced by wheat straw and sugarcane fiber is the most common alternative substitutions for wood fiber in terms of sustainability. In this section, the investigation on environmental impact of producing wheat straw and sugarcane fiber paper will be discussed.

### **2.1 Material Used**

Forest depletion is one of the most critical global issues. In order to achieve more sustainable environment, alternative materials for paper making needs to be found to replace the current wood fiber paper. There are two popular alternative materials: wheat and sugarcane.

One of the main common alternative materials for the paper making is the wheat straw. After the wheat is harvested, large amount of waste will be left. This waste contains mainly grain and other parts of the wheat can be used to in paper production. Current technology is able to make the paper consist up to 95% of wheat waste, while the remaining 5% still require wood fiber to structural purpose of the paper.

Sugarcane fiber is not as popular as wheat fiber in terms of materials for paper making. For the sugarcane fiber paper, one of the company, Ricoh, comes out with the sugarcane paper, TreeFrog paper. This is a by-product of the sugarcane that consists of 70% of bagasse and 30% of recycled bamboo.

### **2.2 Carbon Footprint**

Carbon footprint refers to the amount of carbon dioxide being emitted by an activity, in this scenario, due to the production of paper. In this section, carbon footprint for both wheat straw and sugarcane fiber paper will be discussed.

In calculating the carbon footprint of wheat production, the energy input is first determined and calculate based on the energy coefficient related to greenhouse gas. In the table below, the carbon foot print is calculated and divided into two categories: organic and conventional. In terms of the production of wheat paper, the conventional is the primary data.( J. Fix, S. Tynan, 2011)

Treatment	Fuel & Lube (kg CO <sub>2</sub> /ha)	Fertilizers (kg CO <sub>2</sub> /ha)	Pesticides (kg CO <sub>2</sub> /ha)	Total CO <sub>2</sub> (kg CO <sub>2</sub> /ha)
Conventional	98	131	33	262
Organic	87	0 <sup>15</sup>	0	87

Table X: Carbon Footprint of Conventional and Organic Wheat Production

(J.Fix, S. Tynan (Summer 2011). Carbon Footprint Analysis for Wood & Agricultural Residue Sources of Pulp.)

The data of the exact carbon footprint cannot be found, but due to the idea of using the waste of sugarcane that helps to reduce the pollution due to disposal of sugarcane, the relatively carbon footprint is lower than the wheat fibre paper.

Even though sugarcane may have the lower carbon emission during the process, since the main export country for sugarcane is India, the carbon emission of transportation needs to be considered, while wheat is grown locally at Manitoba.

### 2.3 Carbon Storage

For the sugarcane bagasse paper, the raw material is sugarcane bagasse waste. Sugarcane captures carbon dioxide in the air and through photosynthesis, produces oxygen and stores carbon in the body. Unless the product or waste is burned, and carbon can be stored. This carbon storage characteristic can slow down global warming. However, the only part of sugarcane that is used to produce paper is the bagasse waste. Most part of the sugarcane is extracted to produce food products or bio-fuel. Carbon stored in bio-fuels may later be released back to the atmosphere. Overall, sugarcane can offer carbon storage capacity, but some part of it may be released back to the environment and contribute to global warming.

For the wheat straw paper, the raw material is wheat straw, which is traditionally treated as production waste. Often times the wheat straw waste is burned and spread on the farm field as fertilizers. This contributes to global warming. If the wheat straw waste can be used for paper production, the carbon can still be sequestered not as wheat straw but as paper. Therefore, the carbon is not released back to the atmosphere. If the wheat straw can be used to produce paper, every aspect of wheat can store carbon. [Tristram O., Gregg M., 2000]

## **2.4 Recyclability**

For the sugarcane bagasse paper, the paper can be easily recycled just like traditional wood fiber paper. Since there is no any unrecyclable chemical or material added to strengthen the paper, the paper can be recycled with normal wood fiber paper. Therefore, no extra environmental risk will be involved to implement any change or improvement on the current paper recycling process. In addition, the sugarcane bagasse paper can be recycled for three or four times.[TreeFrog] This can further reduce the environmental impact.

For the wheat straw paper, the paper can also be recycled easily as the traditional wood fiber paper. The methodology for recycling wheat paper is the same as recycling wood fiber paper. Therefore, no further environmental damage is added to the current recycling system. For some wheat straw paper, the fiber is well enough so that they can be recycled and reused up to six or seven times. [Tshirner, U. 2007] Recycling is important for the environment in a way that it reduces the dependency on the original material because even if wheat straw paper does not cause deforestation, there are still some carbon emissions released during the process of acquiring the wheat straw.

## **2.5 Bleaching**

For the sugarcane bagasse paper, after the pulp is prepared, there is one more step before the pulp is transported to the mill. The step is called bleaching, which is to whiten the color of the pulp. Before bleaching, the color of the pulp is usually not white and therefore is

not appropriate for paper. The bleaching process whitens the pulp into bright white color. Without bleaching, the paper product will be black or brown, which are not suitable. During the bleaching process, sodium hydroxide and chlorine gas are added to the pulp.[Poopak, S. 2012] Both sodium hydroxide and chlorine gas are toxic to some extent. Sodium hydroxide is known for its high corrosive chemical property. If sodium hydroxide is released to the environment, it can cause biological extinction to the nearby area. On the other hand, chlorine gas is also toxic. Overall, sodium hydroxide and chlorine gas are two toxic chemicals added into the bleaching process. Without proper treatment, sodium hydroxide and chlorine gas can severely harm the environment.

For the wheat straw paper, after the pulp is prepared, the brightness of the pulp is still insufficient. The targeting brightness is 86 unit of brightness. Therefore, the bleaching process is mandatory. Prior to the bleaching process, the pulp is pre-bleached using oxygen. Oxygen does not cause damage to the environment. However, in the process of obtaining the oxygen, there might be some pollution or environmentally harmful byproducts. After the pre-bleaching, the pulp is sent to a three stages bleaching process. In the three stages bleaching, sodium dioxide and sodium sulfite are used.[The Clean Washington Center, 1997] Sodium dioxide, as mentioned above, is corrosive and can cause harm to the environment. On the other hand, sodium sulfite does not cause significant damage to the environment. However, carbon dioxide is produced as the byproduct of producing sodium sulfite. Overall, oxygen and sodium sulfite may not cause obvious damage to the environment, but the byproduct produced when producing oxygen and sodium sulfite may cause some harm to the environment. On the other hand, sodium hydroxide may cause harm to the environment, and should be treated properly.

### **3 ECONOMICAL ASSESSMENT**

In this section we will discuss the economic aspect of the Triple-Bottom-Line assessment for Sugar-cane fibre paper and Wheat straw fibre paper. We will focus on the Production, Transportation, Retail price, and job creation/ opportunities of each paper.

#### **3.1 Consumer Price**

From the website, [www.ecopaper.com](http://www.ecopaper.com), we found that Sugar-cane paper sold in 5000 sheet packages costs \$69.99 USD (EcoPaper.com, n.d.) compared to the price of Wheat Straw paper sold at 5000 sheets a package at Staples in Canada for \$59.99 USD. From this we can deduce that from an economical point of view, consumers would be more inclined to purchase Wheat straw paper due to its cost. (STAPLES, n.d.)

#### **3.2 Transportation**

Given that sugar-cane paper is imported from international countries such as India, the cost of transporting sugar-cane paper purchased in bulk would be significantly greater than the transportation costs of wheat straw paper purchased in bulk. Since wheat straw paper is purchased locally from Manitoba, the cost of transporting the paper to UBC would be less than that of sugar-cane paper.

Also since wheat straw is compressible and flexible, this would make the transportation of wheat straw more efficient and less costly, thus reducing the overall transportation costs for wheat straw to paper manufacturing factories to retail stores. (Ansari-Gilani, Harris, Jalali, & Xue, 2012)

#### **3.3 Economic Development and Job Creation**

By purchasing sugar-cane paper from international suppliers such as those in India, we will be creating more job opportunities in India due to the increased demand for sugar-cane paper. Through creating more job opportunities in India we will not only be benefiting India's

economy, but also the Global economy. However, we would also be hindering Canada's economy by importing sugar-cane paper from international sources rather than local sources.

By purchasing wheat straw paper from local suppliers such as those in Manitoba, we will be creating more job opportunities within Canada due to the increased demand for wheat straw paper. Through creating more job opportunities in Canada, we will be benefiting Canada's economy. However, we would also be hindering India's economy by not importing sugar-cane paper from them.

### **3.4 Production of Material**

Through research, we found that sugar-cane fiber is produced using a wind mill farm that is able to generate 35.5 Mega Watts of power to run the machines that produce the paper. Also to clean the paper from bacteria and residue, the wind mill farm implements 'a closed loop water cycle and an Elementary Chlorine Free paper cleaning system'. (Cane Fields, n.d.)

Also through research, we found that the production of wheat straw involves the harvested straw to be dried in the open air for approximately 3 days which is not very costly. Afterwards, the dried wheat straw is transported to refineries by using pipelines. 'Pipelines are convenient, fast and they also prevent material loss during the transportation.' (Ansari-Gilani, Harris, Jalali, & Xue, 2012)

## 4 SOCIAL ASSESSMENT

### 4.1 Social Benefits and Disadvantages

The emergence of both wheat and sugarcane paper plays a big role in social influence. There are different social benefits and disadvantages in using wheat paper versus sugarcane paper in Canada. Since wheat is locally grown in Canada, near the prairies region, Canadian farmers have the opportunity to gain extra revenue in the wheat paper industry (The Canadian Press, 2012). The wheat straw that is left over from harvesting can be sold to the wheat paper industry companies for the production of wheat paper. This opens up a new way for the farmers to treat left over wheat straw. Furthermore, in producing wheat-based paper, more local job opportunities are created. According to the Prairie Pulp and Paper President Jeff Golfman, he illustrates that his \$500 million project in wheat paper production can hire about 300 people and requires about 300,000 to 400,000 tonnes of wheat straw annually (The Canadian Press, 2012). However, there is a slight disadvantage in continuously providing wheat straw to the industry. The wheat straw that is left over from harvesting contains a moderate degree of nutrients such as, nitrogen, potassium, and phosphorous (Mullen & Lentz, 2007). The wheat straw is used to fertilize the soil for wheat farms and the continued removal of it can cause a decrease of soil nutrients in the long-run affecting the quality of growth of wheat (Mullen & Lentz, 2007).

In terms of sugar cane paper, there are no job opportunities for Canadian farmers since sugar cane is not grown here. However, in the sugar cane paper industry, companies can open up in Canada to import sugar cane based paper to sell them here. This would increase job opportunities for people. In addition, one benefit of sugar cane paper as well as wheat paper is their similarity in texture compared to wood fiber paper. This makes them more socially acceptable since they don't deviate or differ much from daily used wood paper.

### 4.2 UBC Sustainability Policy

UBC is a renowned university in their achievements in sustainability. The UBC Supplier Code of Conduct puts emphasis on focusing on people, place, and process (UBC

Supply Management, 2008). They include the expectations of the society as one of their guided measures to a sustainable decision. In this policy, UBC states that it requires a minimum of 30% post consumer waste content in all packaging standards (UBC Supply Management, 2008). Currently, the paper the UBC uses contains 30% recycled material. Considering wheat based paper, 95% of wheat residue is reused to make paper. If UBC considers replacing wood fiber paper with wheat paper, the university will be exceeding sustainability standards by 65%. In terms of sugar cane paper, since only 30% of bagasse is extracted from sugar cane to be reused, the paper that is produced will only contain 30% recycled material. The sugar cane paper will only meet, but not exceed, the sustainability standards.

## 5 CONCLUSIONS

Wheat straw paper and sugarcane paper have their own advantage in this environmental assessment. Even though wheat straw paper still requires a small amount of wood fibre and emits larger carbon dioxide during the process, sugarcane paper require a more toxic bleaching material and can only be recycled in less times. In overall, each type of paper has their own advantages and disadvantages and it is up to the consumer to decide which aspect is their priority concern.

From an economical point of view, the cost of wheat straw paper for the consumer is cheaper than that of sugar-cane fiber paper. Given that wheat straw paper is produced in Canada, it would be beneficial to the Canadian economy if UBC purchased wheat straw paper produced locally within Canada than importing sugar-cane fiber paper internationally. Given that the methods for producing the materials for the two types of paper are relatively equal in terms of cost and efficiency, the overall transportation costs for wheat straw paper would be significantly less than sugar-cane fiber paper's.

In the social aspects of the triple bottom line assessment, UBC would be able to reinforce their dedication to sustainability by switching to wheat based paper. Since wheat is grown locally in Canada, it can be supplied locally to UBC and in turn provide an extra income for Canadian farmers. Also, the amount of waste reused in wheat paper exceeds the sustainability standards in UBC and can further strengthen UBC's image and commitment to sustainability. On the other hand, sugar cane paper must be imported and it at most only meets the UBC sustainability standards. As a result, in the social perspective, UBC should make investments in wheat based paper and use it to substitute the current wood fiber paper.

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