UBC Social Ecological Economic Development Studies (SEEDS) Student Report

An Investigation Into Wheat Straw Paper and Wood Pulp Paper Use at UBC

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AN INVESTIGATION INTO WHEAT STRAW PAPER AND WOOD PULP PAPER USE AT UBC

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ABSTRACT

The usages of paper have been integrated in our life for thousands of years. As the demand for paper increases, the environmental impact of paper production has increased over the millennium. This report investigates the economical, social and the environmental impact of wheat paper usage in UBC. The scope of this project is to determine whether replacing 30% post consumer paper with wheat straw paper on the UBC campus will reduce greenhouse gas emission, benefit British Columbia's economy and determine Canada's ability to produce wheat paper on a mass scale. In the social section of the report, a survey was conducted regarding the quality between 30% post consumer fiber paper and wheat straw paper. In the environmental section of the report, the 30% post consumer fiber paper and wheat straw paper were compared based on the emission during production of the two types of paper. In the social section of the report, the difficulties of producing wheat paper are discussed and barrier preventing the widespread of wheat paper in all parts of Canada.

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Glossary

Electrostatic precipitator:	A device which uses the induced electrostatic charge to remove particles from the flowing gas.
Oxygen delignification:	A process used to remove the lignin from unbleached pulp in the pulp and paper industry .
Silica:	Silicon Dioxide.
Factor of production:	An economic term which includes the inputs used in producing of a good or service for the purpose of making a profit
Commodity:	Any marketable item produced in order to satisfy the needs.
Minimum support price: (India)	The minimum price at which harvested grains are sold.
pH:	Measure of the acidity or basic

List of Abbreviation

GDP:	Gross Domestic Product

1.0 INTRODUCTION

Paper production in the world today mostly comes from wood. There is now increasing awareness for conservation of the world's forests, and demand for an alternative paper source is wanted to feed the need for paper. However many nations including Canada have a thriving forestry industry that is committed to environmental protection while contributing greatly to GDP. The forestry and pulp paper industry in British Columbia employs thousands of people and is a huge contributor to revenues for all three levels of Canadian government. Moving away from wood pulp paper may result in a recessionary gap in the forestry and wood pulp sector in British Columbia, therefore a switch in paper source must be carefully assessed.

This report will analyze two types of paper. The first type of paper is the 30% post-consumer fiber currently used in UBC. It is composed of 30% post recycled paper and 70% virgin forest wood pulp. The second type, wheat straw paper, is made from the by-products of wheat harvesting. The wheat straw paper is produced in India, the second largest producer of wheat in the world.

In this report the two types of paper will be compared with respect to the triple bottom line and assess their feasibility to be used at UBC. The paper used at UBC must perform exceptional at all the pillars of the triple bottom line, which include environmental, economical and social factors.

2.0 ENVIRONMENTAL IMPACTS

Is wheat paper more environmentally friendlier than conventional wood paper? Both kinds of paper production process are very similar; a deeper investigation of the materials required to produce each type of paper was implemented.

2.1 WOOD PULP PAPER

The usage of wood pulp for paper production has been done for thousands of years. An investigation will be done to determine the amount of greenhouse gases produced during the production, transportation and recycling process of wood pulp paper.

2.1.1 CHEMICAL PULPING

Wood enters the pulp mill as wood chips. If the logs were sent to the mill, it will be chopped down to specific size then before proceeding to the next step. When the wood chips are sent to the mill, the purpose of the mill is to separate cellulose fiber from lignin. Lignin is the material that connects the cellulose fiber together. As a result, lignin fibers are extracted and cellulose fiber is retained for paper making. This process is known as pulping. In the wood and paper industry, chemical pulp accounted for more than 80 percent of US pulp production (Schrock, 2010).

During chemical pulping, the pulp is positioned in an aqueous solution then heated to a certain temperature and pressure to extract the pulp fiber. The two most common types of chemical processes are the kraft pulp process and sulphate pulping process. In the former process, the aqueous solution containes sodium hydroxide and sodium sulfide while the latter used sulfurous acid and bisulfate ion (Chan et al. 2005).

2.1.2 BLEACHING

The purpose of the bleaching process is to remove the color from the cellulose fiber. The most common bleaching chemicals are chlorine, chlorine dioxide, hydrogen peroxide, oxygen, caustic, and sodium hypochlorite (Schrock, 2010). The formation of chlorinated compound will pollute surrounding environment. As a result, a water treatment plant is needed to treat the water into the desired pH and remove residue before being sent to wastewater sewers.

2.1.3 CHEMICAL RECOVERY

The purpose of chemical recovery is to clean and reuse the aqueous solutions for future pulping. In the Kraft pulp process, the aqueous solution at end of the pulping process is a mixture of extracted product and sodium hydroxide and sodium sulfide. The mixture is heated until the mixture reached a solid content of 50 percent (Schrock, 2010). The solution is oxidized to further increase the solid content percentage. The mixture is then sprayed onto the recovery furnace to combust organic compounds. The evaporated and collected in an electrostatic precipitator and added back to the mixture for further heating. At the bottom of the furnace laid molten inorganic salts, which will be washed to extract and lime was added to the solution to create. The solution flows through a series of tank removing from the mixture. The substance is washed and the molten substance was dissolved in the furnace to create sodium hydroxide and sodium sulfide used in the pulping process.

2.1.4 PAPERMAKING

The processed pulp is made into stock for papermaking. The pulped is placed in water and then pressed to squeeze. As a result, the water content inside the pulp is removed and the chemical inside the pulp could be diluted further. The paper sheets are then put through a dryer to dry then coated if necessary. Refer to Appendix A for emissions from paper making and recycling wood pulp paper.

2.2 WHEAT PAPER

Wheat paper is good for the environment in terms of saving trees in Canada or anywhere around the world (González-García et al. 2010). Wheat paper production is identical to wood paper production, but wheat paper enables us to transform what was considered waste, wheat stems and stalks, into printable paper. This investigation leads us to another problem - should we import wheat straw paper from India when Canada has the potential to produces wheat straw paper on a mass scale?

2.2.1 WHEAT PAPERMAKING

Wheat straws, a by-product of grain production, are a great source for paper production. Currently, only 10% of wheat straws produced in Canada are being used in generating heat and electricity, and 90% of them are discarded. Canada produces approximately 8 million tons of pulp from wheat straws, which is equivalent of 100 million trees in terms of producing paper. The amount of wheat straw produced is enough to supply the entire consumption of newspapers in North America (Edwards 2008).

2.2.2 WHEAT PAPER BLEACHING

After the wheat straws are collected, the straws are washed then air dried (Roncero et al. 2003). Sodium Hydroxide is used as a cooking agent and followed by oxygen delignification, which is the process of adding oxygen into the pulp. This process is the only known commercial whitening process that is 100% environmentally friendly because the water can be reused (Jiménez et al. 2001). Once whitened, the pulp is pressed and cut into sheets of paper.

2.2.3 WHEAT PAPER RECYCLING

The recycling process of wheat papers is similar to wood papers recycling. Used wheat papers are first beaten into small particles, a process called re-pulping. The particles are then thrown into a tank for bleaching. The water used for this process can be reusable for several times (Jiménez et al. 2001). After bleaching, the re-pulped materials are ready for papermaking.

2.2.4 WHEAT PULP TRANSPORTATION

The average container ships would emit 12 kg of CO2 per kilometer per tonne of load (Psarafti, 2009). The distance from the city of Mumbai, India is 27,620 kilometer. As a result, shipping a tonne of wheat straw from India to Vancouver would result in 331 tonnes of CO2 emitted into the atmosphere.

3.0 SOCIAL IMPACT OF THE WHEAT STRAW PAPER

The wheat straw paper appears to be more environmentally friendlier compared to conventional wood pulp paper. However, many social issues also arise, namely regional limitation of the raw material, people's awareness on sustainability, and the technological limitations to the production of the wheat straw paper.

3.1 Regional Limitation of Raw Materials

The application of wheat straws can be used to make fuels, alcohols, animal feeds. However, during wheat harvesting seasons, astounding amounts of wheat straws are produced but most wheat straws are discarded. Correspondingly, the usage of wheat straw to produce paper can minimize the amount of discarded wheat straw. Research has shown that wheat straw is only available in the regions with black soil. As a result, the Prairies can supply steady amounts of wheat straws (Watson et al. 1998). In other words, wheat straw products are only readily available in certain parts of Canada, so a economic and environmental assessment needs to be done to determine how efficiently to wheat straw paper can be supplied to other parts of Canada where there exists a pulp and paper industry.

3.2 Technological Limitations

The current technology used for the production of wheat straw paper is much more complicated than the wood counterparts. The wheat straw contains 6% to 11% of ash. In order to produce wheat straw paper, the ash must be reduced by 60% before paper production can begin (Watson et al. 1998). However, there is no ideal solution to remove the ash as of now. To add to the complexity, wheat straw paper has relatively low tear strength. As a result, the procedure needs to be closely monitored to minimize defections (Jiménez et al. 1998). In short, wheat straw paper production needs precise procedure and the margin of error is minimal compared to conventional paper productions.

3.3 Primary Social Research

As seen in Figure 1, the preference is clearly favouring the wood paper as overall the paper someone would prefer to use. This is mostly due to the fact that it is whiter and that seems to be a determining criterion people look for in their paper. The environmentally friendly bleaching process does not attain the same level of quality as the standard wood paper.

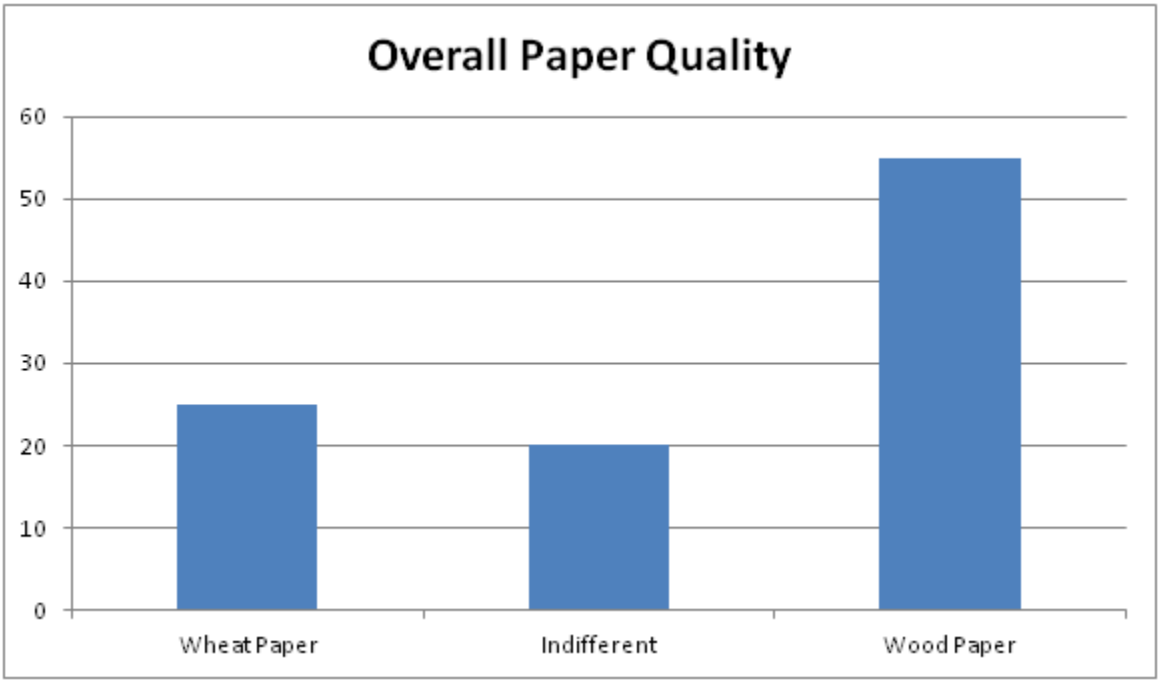

Figure 1: 100 person surveys on paper preference

From Figure 2 the printing quality is pretty even and show there is good quality to the wheat paper. The difference is not large enough to say that one is better than the other. Based off of this sample size there shows comparability in the two products.

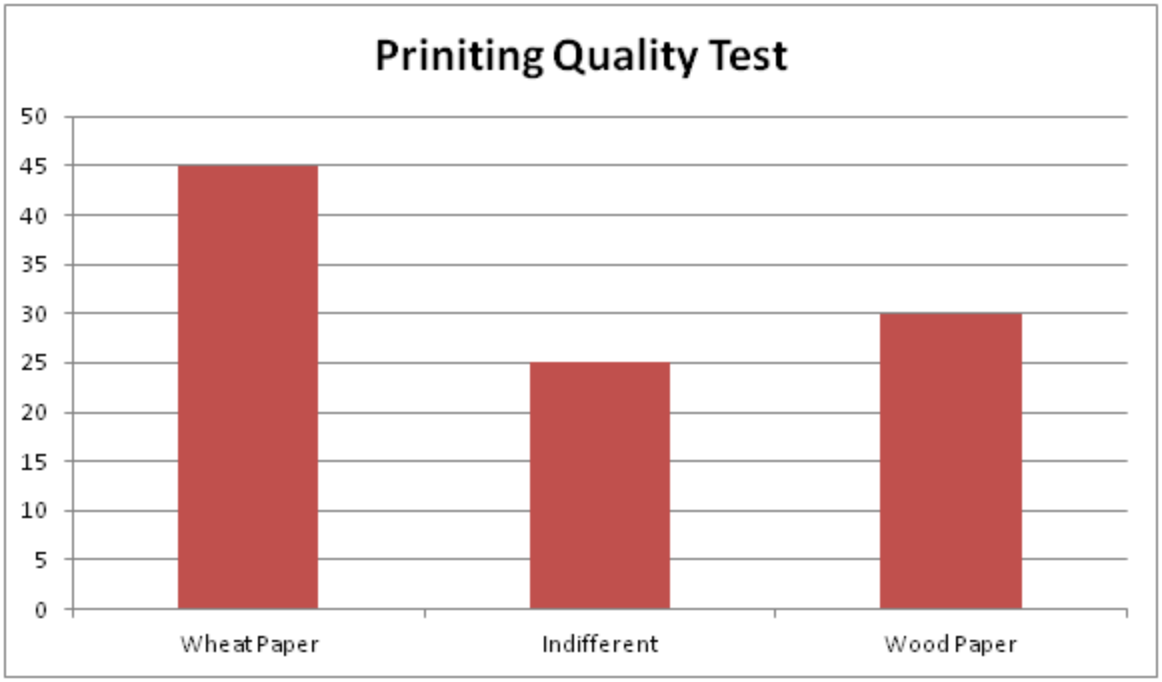

Figure 2: 100 person surveys on paper preference when writing or printing

4.0 ECONOMIC ANALYSIS

Prices per sheet for wood pulp paper and wheat straw paper are pretty much similar, but this is based on current consumption where consumption of wood pulp paper is greater than wheat straw paper. British Columbia's forestry sector and India's wheat industry will be analyzed for their contributions to the production of these two types of papers. The prices for materials to make these two types of papers are all subjected to supply and demand, thus they can vary from the short run to the long run. Wheat straw paper is made from the stem and stalk, waste product from wheat farming, and it generates a source of income for the farmer if it is sold for wheat straw paper production.

4.1 Short Term Impacts

As stated previously the cost per sheet is marginally different and would make the switch simple in terms of cost. The wheat straw paper is produced in India, therefore the costs are less for labour. The bleaching process for wheat paper is cheaper as it uses fewer chemicals and the water can be reused after each bleaching (Jiménez et al. 2001). Also, the method for recycling is the exact same which means it is already in place and would not incur extra cost. This means the switch for UBC would be effortless to get to pass based on cost and makes the short term not a big issue.

If the switch were to occur the immediate impact would be seen to the BC economy which is reliant on the forestry and pulp paper industry. Currently the forest sector holds 15.4% of the provinces labour force and creates 1.2 million additional jobs in the economy. It is a profitable but volatile business, as a 10% decrease in foresting will cause a loss of 30,000 jobs and 2 billion dollar loss in provincial GDP (Binkley et al. 1994). The pulp and paper industry alone employs over 10,000 people and contributes nearly $600 million in revenue for all three levels of the Canadian government (Horner, 2006). UBC switching to wheat paper may cause a slight loss in production in pulp paper as UBC uses 53 million sheets of paper per year (Goldspink, 2012). The pulp paper industry in British Columbia is still on a road of recovery after many years of decline in production; therefore it is crucial local business support this sector

of the industry (Horner, 2006).

4.2 Effects on the Economy of India

Wheat commodity prices need to be taken into account because it is the material source for wheat straw paper. India is the second largest producer of wheat in the world, at 75 million tons in 2007 and projected to increase in the next decade, therefore obtaining the supplies for producing wheat straw paper should not be a problem in the near future (Joshi et al. 2007). The problem arises in the long run due to the instability of world wheat prices. The stems and stalks are factors used in the production of wheat straw paper can be used by farmers as a secondary source of revenue. The wheat production in India is highly subjected to the weather (floods, monsoons, droughts, etc.), the prices will vary in return (Bhaskar, 2010). Wheat prices are regulated by the Indian government by Minimum Support Prices (MSP), but farmers can set the price for the stems and stalks however then want. For example, if the amount of wheat stock harvested in a year is lower than the target level, the farmer will earn less from the stock itself, but may choose to increase the price of factors used in the production of wheat paper. As stated above, UBC's annual paper consumption is 53 million sheets of paper. If UBC was to switch completely to wheat straw paper, 238.5 tonnes of wheat straw paper must be imported from India. This amount of paper import will have a small effect on the economy of India. Prices are not expected to rise for wheat straw paper based on the increase in UBC's consumption because demand is not high enough to raise prices significantly. This is comparing UBC's yearly consumption to India's wheat exports per year (Choudary, 2008).

UBC must watch the world trend on wheat paper usage if a switch to wheat straw paper was to be made. The North American newspaper industry has the potential to switch to all wheat paper for printing (Edwards, 2008). If the North American newspaper industry were to use wheat straw paper from India for printing, around 8 million tonnes, this would result in an significant increase in revenue for India exporters of wheat straw paper. Also this will increase demand significantly, too, giving Indian producers the ability to increase factor of production prices of wheat straw paper.

5.0 CONCLUSION

There are benefits to using both wood pulp paper and wheat straw paper. It is important to recognize that the paper used by UBC should be exceptional on all pillars of the triple bottom line. After assessing the production and usage of both wood pulp paper and wheat straw paper, it was determined that the 30% post-consumer waste paper was the best choice. This was determined after applying the triple bottom line to both wood pulp paper and wheat straw paper. In terms of the economic aspect, the pulp and paper industry in British Columbia employs over 10,000 people and contributes greatly to the province's GDP. With respects to social factors, the wood pulp paper wins again due to the fact it is made in British Columbia, and it supports British Columbia's industries. The wheat straw paper, however, must be shipped from India. In terms of environmental factors, wheat straw paper is more environmental in the production process because it uses more environmental friendly chemicals than wood pulp paper, which uses chlorine. The recycling processes of the two types of paper are the pretty much similar. The major problem with wheat straw paper arises from shipping – it has to be shipped by container from India, thus making it not as environmentally friendly as using wood pulp from the forest of British Columbia. This shipping process accounts for a great fraction of emission from the use of wheat straw paper from India, which brings us to our recommendation. We recommend using the 30% post-consumer waste paper because it supports local industry and benefits the economy of British Columbia. As we account for the life cycle of wheat straw paper and wood pulp paper, the biggest determinant of wood pulp paper over wheat straw paper is location; because of shipping the amount of wheat straw paper UBC needs from India annually is the biggest contributor to greenhouse gas emissions. The stems and stalks gathered from grain production in Canada alone can support the amount of paper needed for the North American newspaper industry annually. Developing and building wheat-pulping plants in Canada will boost jobs in the farming sector and create new jobs in wheat pulping. It is a much efficient way to raise awareness of sustainability within Canada.

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APPENDIX

Table 1: The Emission from paper production (Schrock 2010)

Emission Sources	Tonnes of greenhouse gas emitted per tonne of paper produced
Direct Sources:	
Fuel combustion - Boiler	**0.6425**
Waste water treatment	**0.00445**
Treatment and disposal of solid waste	**0.0245**
Chemical recovery process	**0.0043**
Indirect Emission:	
Electricity needed to run the mills	**0.282**
Total	**0.9578**
Secondary Sources: (i.e Turning paper to card box)	
Paper manufacturing operations	**0.0278**
Electricity for second manufacturing sources	**0.0991**
Total	**1.0847**

Table 2: The greenhouse gas emission from transporting pulp, newspaper and paper (Upton 2008)

Materials needed to transport	Method of transport	Average Distance	Emissions (per tonne of log per mile)	Total Emission
Pulp, newsprint, paper, paperboard	72% by truck	156 miles	0.208 tonnes	32.448 tonnes
	28% by rail	857 miles	0.0295 tonnes	25.2815 tonnes
	Weighted Average			30.44 tonnes of emission

Table 3: Total Emission from transporting and production of paper

Total Emission	31.52 tonnes of CO2

Table 4: Emissions from producing 30% post consumer fiber paper

Emission source	Content of 30 post consumer fiber paper	Kg of greenhouse gas emitted per tonne of paper	Total Emissions
Producing Paper	70%	31,520	22,064
Recycled Source	30%	1791.1	537.33
Total			22601.33 kg or 22.61 tonnes emitted

Table 5: Greenhouse Gas emission from paper recycling (Ford 2008)

Emission Sources	**Kg of Greenhouse gas emitted per tonne of paper recycled (virgin paper)**		**Kg of greenhouse gas emitted per tonne of paper recycled (recycled paper)**
Transportation and harvesting	152.5	**Collection and sorting**	94.7
		Waste Disposal	3.4
Landfill:			
Collection and landfill equipment	33.6		
Internal transportation and the production of chemicals	1,497.7		1676.5
		Transportation of fiber	16.5
Tree Fiber Balance	1333.4		
Total	3017.2		1791.1

Table 6: Greenhouse Gas emission from recycled 30% post consumer fiber paper

	Content of 30% post consumer paper	**Kg of greenhouse gas emitted per tonne of paper recycled**	**Total**
Virgin paper	70%	4329.2	3030.44
Recycled paper	30%	1791.1	537.33
Emission from recycling 30% recycled and 70% virgin paper			3567.77 or 3.57 tonnes