

An Investigation into Wheat Straw Paper

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APSC 262

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AN INVESTIGATION INTO WHEAT STRAW PAPER



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ABSTRACT
“An Investigation into Wheat Straw Paper”

Wheat paper made from discarded wheat straw has become a viable option and alternative that rivals 30% PCW paper in today’s society that is focused on sustainability. In an attempt to improve the sustainability of UBC, wheat paper is to be considered. This report will focus on the triple bottom line assessment of wheat paper to determine if it is acceptable to be used at UBC instead of the standard 30% PCW paper. Three aspects of wheat paper will be reviewed. These include the environmental, economic and social impacts that are associated with how beneficial or consequential wheat paper is compared to 30% PCW paper. Environmental aspects include the amount of energy required to produce the paper, the materials required and the overall life cycle. In terms of economic factors we analysed the costs and its benefits and consequences. Lastly, we examined the social aspects which included labour and benefits and consequences wheat paper can have on society.

When performing the analysis many ideas brought up by Minto Roy from Royal Printers in an interview have been taken into account and a transcript is available in the Appendices. It is also assumed that the facilities in India where the wheat paper is made meet all requirements of UBC’s Supplier Code of Conduct.

This report ultimately finds that wheat paper is a compelling option for UBC to choose from compared to 30% PCW paper because wheat paper production emits less CO₂ emissions, reduces the amount of trees used in paper compared to 30% PCW by 7 times, may reduce consumer prices on grain products if demand increases, and is available at the same price point.

TABLE OF CONTENTS

ABSTRACT.....	ii
LIST OF FIGURES.....	iv
GLOSSARY.....	v
LIST OF ABBREVIATIONS.....	vi
1.0 INTRODUCTION.....	1
2.0 ENVIRONMENT.....	2
2.1 ENERGY.....	2
2.2 MATERIALS.....	3
2.3 LIFE-CYCLE.....	4
3.0 ECONOMICS.....	5
3.1 COST.....	5
3.2 BENEFITS AND CONSEQUENCES.....	6
4.0 SOCIAL ASPECTS.....	7
4.1 LABOUR.....	7
4.2 BENEFITS AND CONSEQUENCES.....	8
5.0 CONCLUSION AND RECOMMENDATIONS.....	9
REFERENCES.....	10
APPENDIX: INTERVIEW WITH AN INDUSTRY PROFESSIONAL.....	12

LIST OF FIGURES

FIGURES

Figure 1: The wheat straw that is used in the production of paper.....	3
Figure 2: Visible Effluent Discharge from the Georgia-Pacific Pulp Mill in Toledo.....	4
Figure 3: National Lumber Exports in Canada.....	6
Figure 4: The number of employees in the Canadian sawmills and wood preservation industry.....	8
Figure 5: A cow enjoying his straw meal.....	8

TABLE

Table 1: Ecological Footprint of Wheat Straw/Wood Fibre.....	3
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GLOSSARY

Canopy Planet	A non-profit, non-governmental organization dedicated to protecting forests, climate and species.
Clear Cutting	Forestry/logging practice in which most or all trees in an area are uniformly cut down
Ecological Footprint	Measure of human demand on the Earth's ecosystems
Eucalyptus	The most common short fibre source for pulpwood to make pulp
Forest Stewardship Council	A non-profit, non-governmental organization to prevent deforestation by promoting the responsible forest management
Post Consumer Waste	Fibre from used paper which includes newsprints, magazines and paper from office waste
Retrofit	The addition of new technology or features to older systems
Virgin Wood Fibre	Non-recycled wood fibre that is primarily extracted directly from trees

LIST OF ABBREVIATIONS

BC	British Columbia
CO ₂	Carbon dioxide
CNAD	Center for a New American Dream
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
kg	Kilograms
MJ	Megajoules
PCW	Post Consumer Waste
UBC	University of British Columbia

1.0 INTRODUCTION

Wheat paper is a type of paper in particular that has been approved by Canopy Planet*. Their support makes wheat paper a practical option in the paper industry in terms of environmental friendliness that is comparable to 30% Post Consumer Waste* (PCW) Paper. In addition to the amount of recycled waste used in 30% PCW paper, wheat paper is also made from post consumer waste as well. After wheat has been harvested from the farms, it is produced into various end products. There is a component of wheat that is unused and is usually discarded or used for scraps. This component is the wheat straw which is the main component in the production of wheat paper.

The demand for sustainable paper is increasing in the Canadian paper industry and as a result, environmental, social and economic impacts are big issues that factor into their production against normal wood fibre paper. However, the idea of using wheat paper is not new. The idea has been around for centuries. Nonwood fibres such as wheat straw have a long history as a raw material for papermaking. The use of this raw material declined in Europe and North America during the first half of this century as the amount of inexpensive and readily available wood fibre increased. As of today, 30% PCW paper has gained much popularity in regards to sustainability. To be more specific, University of British Columbia (UBC) has been in contact with Royal Printers to switch to wheat paper from the current 30% PCW paper used.

This report will perform a triple bottom line analysis on wheat straw paper and its feasibility of usage compared to 30% PCW which is the current standard at UBC. The environmental, economical, and social factors surrounding 30% PCW and wheat straw have been reviewed. The environmental aspects that were covered are wheat and wood fibre paper such as energy, materials, and life-cycle. This is followed by the cost, benefits, and consequences on the economical side of the scale. Lastly, social issues such as labour are analyzed.

* This term and all subsequent terms marked with a * will be defined in the Glossary (v).

2.0 ENVIRONMENT

Wood fibre remains as the leading material in our paper manufacturing process because of its relative ease of production, however the amount of clear cutting* being done has been devastating. UBC currently uses 30% PCW, but that only reduces the amount of logging by so much. With non-wood fibre papers being predominantly produced in India and China, Royal Printers is looking to bring this market to Canada. Wheat straw is emerging as a compelling alternative to wood fibre for a number of environmental reasons.

2.1 ENERGY

Refer to Table 1 for a compact version of the ecological footprint* of wheat and wood fibre. The energy input per hectare of wheat goes as high as 4221 mega joules for conventional and 1268 for organic. For conventional wheat production there is an average of 262 total kg CO₂/ton while logging and chipping spruce wood produces 89 kg CO₂/ton (Fix, 2011). For the pulping procedure there are 606 kg of CO₂ produced for wheat straw pulp and 536 kg of CO₂ for aspen and spruce pulp (Kissinger, 2007). Although these numbers support wood logging, it must be taken into account that trees are not typically farmed as they take at least a decade to grow. On average 0.7 hectares of cropland is required to grow enough fibre for one tonne of wheat straw pulp, but an astounding 4.6 and 2.3 for spruce and aspen respectively. In Manitoba, 0.6 hectares of wheat straw residue is capable of relieving up to 5.6 hectares of spruce logging (Kissinger, 2007). This translates into 2955 MJ of energy put into producing enough wheat for a tonne of wheat pulp. At the paper production level, a tonne of 30% PCW paper requires an energy input of 31.85Btu*, with 57% coming from purchased energy and 43% from generated energy. Producing wheat paper, however, can take up to 10% less energy to create (Borromeo, 2008).

Wheat Straw	Wood Fibre
4221 MJ/hectare energy input	no energy inputs
262 kgCO ₂ /ton wheat production	89 kgCO ₂ /ton of logged chips
606 kgCO ₂ /ton wheat pulp produced	536 kgCO ₂ /ton of wood pulp
0.7 ha of cropland/ton pulp	avg of 3.45 ha/ton of pulp

Table 1: Ecological Footprint of Wheat Straw/Wood Fibre

2.2 MATERIALS

The Social Wheat Paper is made up of roughly 90% wheat straw residue but still contains 10% wood fibre which contains the eucalyptus* necessary for structural rigidity in the paper. Although one day there are plans to reach 100% wheat straw, for now technology allows up to 95% wheat residue. For each tonne of 30% PCW paper, 17 trees are harvested on average while the wheat straw paper would take less than 3 (Borromeo, 2008). At UBC approximately 265 tonnes of paper is used each year. Those numbers translate to 4505 trees cut down each year to satisfy UBCs yearly paper usage, while the wheat sheet could lower those numbers down to 800 trees per year. It's also important to note that the wheat sheet only uses Forest Stewardship Council* (FSC) forest free wood fibre. These FSC certified eucalyptus trees are regrown on farms every 7 years contrast to forest trees which may take several decades. Most of the wheat straw produced in Canada is considered purely waste yet there is enough of it in Canada to produce 8 million tonnes of pulp from wheat harvest per year.



Source: <Royal Social Print Wheat Paper>

Figure 1: The wheat straw that is used in the production of paper

2.3 LIFE-CYCLE

There are many initiatives for clean water for distillery purposes at the production facility in India. The bleaching process of the wheat paper uses hot water with a sodium salt and oxygenation process rather than using chlorine gas and chlorine dioxide or peroxide as bleaching agents, making the production of wheat paper effectively chemical free. The hot water in the wheat paper mill is recycled over and over again with no effluent coming out of the facility. For wood pulping at chemical pulp mills, chlorine gas and chlorine dioxide are highly toxic and pose a severe health risk by acting as a mutagen or carcinogen and may be fatal. Moreover, waste water, leachate and run-off can contain toxic substances that can potentially pollute other fresh water sources and farmlands. High biological oxygen demand and chemical oxygen demand effluent consume the dissolved oxygen in water, potentially causing aquatic lives to be suffocated (Borromeo, 2008). There are no effects on human food chains that go into grains, bio fuels, or other animal food chains because all of the wheat straw is waste. The wheat paper can be recycled the same way as all other wood fibre papers because the molecular decomposition of eucalyptus is the same. The process of creating wood fibre paper includes debarking, chipping, pulping, bleaching, and pressing/drying. With wheat fibre paper debarking and chipping is unnecessary, effectively removing two steps from paper production (Borromeo, 2008).



Source: <http://oregon.surfrider.org/newport/page/7/>

Figure 2: Visible Effluent Discharge from the Georgia-Pacific Pulp Mill in Toled

3.0 ECONOMICS

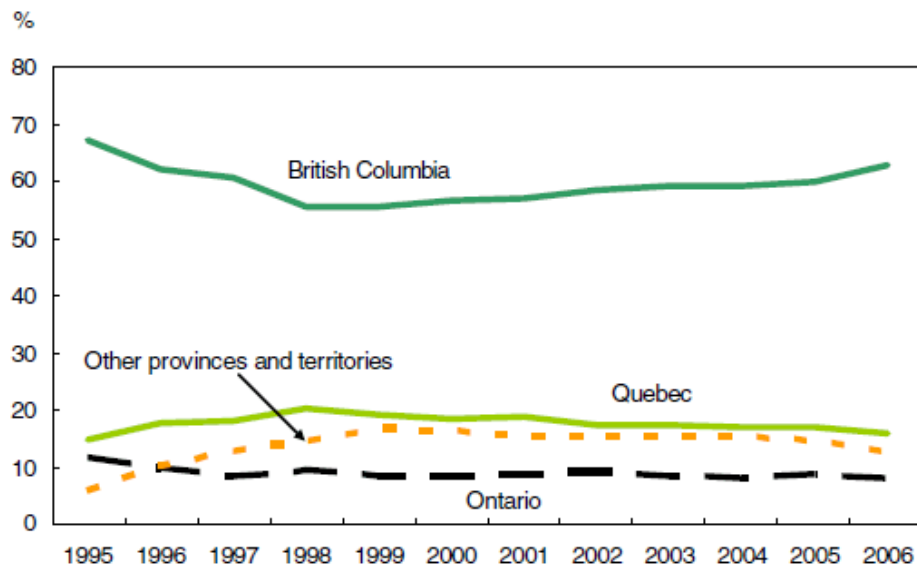
Currently in North America, there is not a single mill that can produce wheat paper. There appears to be absolutely no demand for wheat paper despite the environmental benefits. The scepticism is most likely generated from the initial cost and large investment required to make and install the necessary tools to produce wheat paper.

3.1 COST

According to a survey in 2004 conducted by the Center for a New American Dream, the average price for 30% PCW paper is \$25 per case. The price gets more expensive as the amount of PCW increases and cheaper as the amount of PCW decreases. When compared to virgin wood fibre* paper, 30% PCW paper is 8% more expensive (CNAD, 2005). Wheat paper that is provided are priced within the same range as virgin wood fibre sheets, therefore the cost of wheat paper is cheaper than 30% PCW paper. Furthermore, the production costs for wheat paper are up to 10% cheaper than virgin wood fibre paper as stated by Royal Printers. As a result of the cheaper production costs, wheat paper is still noticeably cheaper to make than 30% PCW paper due to the fact that PCW paper still uses the same methods as virgin wood paper to a lesser degree. As a result of the cheaper production costs, wheat paper is still noticeably cheaper to make than 30% PCW paper due to the fact that PCW paper still uses the same methods as virgin wood paper to a lesser degree. One thing to take note of is that currently there are biomass to fuel projects that could potentially use waste such as wheat straw as a form of energy, this could potentially compete with wheat paper and drive costs up (Hunter, 2007). The wheat paper which would be stocked by Unisource, whom UBC currently gets their supply from, has the price point for the wheat paper being “about the same as 30% PCW” as confirmed by Minto Roy from Royal Printers.

3.2 BENEFITS AND CONSEQUENCES

There are benefits and consequences that will affect the economy if wheat paper becomes more popular in the paper industry. One of the major benefits in the production of wheat paper is that the price of other wheat based products could rise due to the increase in demand for wheat paper. Only the wheat straw is used for paper, which is purely waste, so there would be an abundance with the extra wheat harvested. If wheat paper emerges, prices of bread, flour, cereal, and other bakery goods may see slight price drops due to excess wheat. Conversely, British Columbia heavily relies on their lumber industry and accounts for the majority of their exports. Over the years this type of export has been dwindling. In 2008 lumber exports were less than 30% of the total exports from BC (“Forestry & Logging”, 2009). This may further impact their industry economically if there is less demand for wood fibre paper. With increased demand in wheat straw, North America could see its first wheat pulping mills which would cut down on importing goods because it could be manufactured locally. Furthermore, transportation costs would be greatly reduced as there would be no need to get it shipped from India to Canada.



Source: Statistics Canada, Manufacturing, Construction and Energy Division.

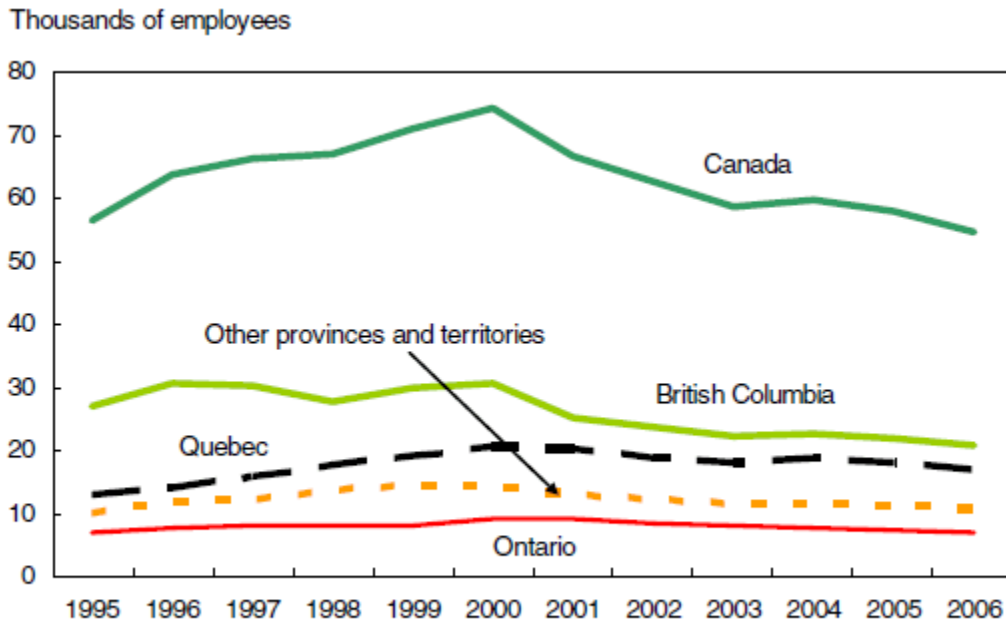
Figure 3: National Lumber Exports in Canada. How would this be affected if wood paper was phased out

4.0 SOCIAL ASPECTS

30% PCW paper is already becoming a predominant standard for paper usage in Canada. While it is socially accepted due to its recycled nature, wheat paper is a growing rival in a society that has become more focused on sustainability. Wheat straw is considered as an agricultural residue and can be a good substitute for wood based pulp in the paper industry. It provides development in rural areas as well as more opportunities to employ sustainable tactics. However, there are several problems associated with wheat straw that need to be resolved in order for it to be more socially accepted for widespread usage.

4.1 LABOUR

A major problem with wheat straw is the tools needed to produce such a product. There is not enough demand for this type of paper due to the high costs of the required machinery. Retrofitting* existing paper manufacturing facilities is also a big investment that ranges from 2 to 5 billion dollars. However, retrofitting does not provide any new forms of employment or unemployment. Switching to wheat straw as the primary paper material has a high probability of creating unemployment within the lumber industry. In Canada's lumber industry, over 57,500 direct jobs (excluding wood products) and 250,000 indirect jobs have been created ("Pulp and Paper", 2010). The dangers of unemployment in the lumber industry would cause concern in the decision to switch to wheat paper because it contributes up to 3% of the Canadian GDP ("Pulp and Paper", 2010). In contrast, this would create more employment opportunities for farmers in Canada. As the demand for wheat straw increases, so will the profits in the farming industry. More opportunities for profit will create more jobs for potential farmers.



Source: Statistics Canada, CANSIM table 281-0024.

Figure 4: The number of employees in the Canadian sawmills and wood preservation industry. How much further would it decline if wheat paper were to phase out wood paper?

4.2 BENEFITS AND CONSEQUENCES

Wheat straw is considered as waste material after it has been harvested. One benefit is that wheat straw will not simply be thrown away because wheat paper makes full use of the unused portions. Though wheat straw is also used to feed animals such as cattle, there is still a substantial amount thrown away. One attribute to monitor closely is the fibre length. Fibre length of wheat straw is 1.18mm on average, for spruce the average is 2.50mm. Length is directly proportional to the strength of the pulp, so there may be performance issues with wheat paper (Singh, 2011).



Source: <http://grassrootsmysticism.com/>
Figure 5: A cow enjoying his straw meal

5.0 CONCLUSION AND RECOMMENDATIONS

Wheat straw residue is found to be a promising alternative to normal wood fibre as a source of paper production. It would be beneficial for UBC to switch from 30% PCW paper to wheat paper as it is a more environmentally friendly and economically viable feedstock that can set an example for other paper industries within Canada to follow. In terms of CO₂ emissions, wheat paper is the better choice because it emits less CO₂ than 30% PCW paper. Furthermore, when producing 30% PCW in a chemical pulp mill, toxic chemicals are used and are classified as carcinogens that are fatal to the environment and its inhabitants. This is because PCW paper still uses the methods that are required for manufacturing virgin pulp paper at a lesser extent. The amount of trees required to produce one tonne of 30% PCW is seven times greater than one tonne wheat paper and is available to be purchased in the same price range. Based on these findings, it is recommended that UBC switch their standard paper usage from 30% PCW to wheat paper as it is more sustainable and financially superior. If a prestigious university such as UBC were to adopt wheat paper, others may follow suit and start a domino effect creating an opportunity for North America to build their own wheat pulp mill so that there would be no need to import from India. The main paper supplier to UBC, which is Unisource, would still offer 30% PCW paper for purchase in the event that wheat paper does not live up to its expectations.

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APPENDIX: INTERVIEW WITH AN INDUSTRY PROFESSIONAL

On Feb 28th, 2012 Minto Roy from Royal Printers came to UBC to give a speech on the Social Wheat Paper and conducted a Q&A session. Roy is founder and president of Careers Today Canada and proposed the idea of using the Social Wheat Paper. Below are some notes taken from a recording from his speech and questions he answered.

- Many initiatives for clean water for distillery purposes
- No effect on human food chains that go into grains/bread, bio fuels, or animal food chains
- Paper made up of about 90% wheat residue, 10% wood fibre for the eucalyptus required for structural rigidity.
- Same price point as wood fibre sheets
- Approved by and working alongside Canopy Planet, a non-profit organization known for their campaigns on forest protection
- Seeded, farmed, harvested, converted to pulp, chlorine free, packaged, distribution process all these things validated by canopy planet
- Demand never high enough to retrofit mills to convert wheat straw to paper, retrofitting is quite expensive. Talks in Calgary may have some retrofitting potential.
- According to Royal Printers, production costs are up to 10% cheaper than wood fibre, but the investment is huge.
- Chemical free, chlorine free during production, hot water recycled over and over again.
- No demand, there is enough wheat straw to use in Canada, but refitting is the problem, completely new machinery needed for wheat pulping.
- Idea of using wheat paper is ancient, bringing it to the same standard and market is new.
- Prices of bread and other wheat based products may go down if there is a large demand for wheat as more would be farmed.
- Jobs would obviously be lost in regards to tree clear cutting, but obviously new job opportunities would arise if wheat became the standard
- Same recycling process as other paper. Same molecular decomposition of the eucalyptus.