

**An Investigation Into Wheat Paper at UBC**

**Jobin Ansari-Gilani**

**Donald Harris**

**Siavash Jalali**

**Yutai Xue**

**University of British Columbia**

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**APSC 262  
SUSTAINABILITY REPORT**

**An Investigation Into Wheat Paper at UBC**

**Prepared for Dr. Dawn Mills  
March 29, 2012**

**Jobin Ansari-Gilani**

**Donald Harris**

**Siavash Jalali**

**Youtai Xue**

## **Abstract**

Wheat straw is an agricultural waste product which is currently unused in any heavy industrial processes. UBC has been approached by a company which sells paper produced from this material. This paper attempts to collect general information regarding the economic and sustainability differences between the two products. The goal is to present a suggested course of action in order to aid UBC in their decision about whether or not to adopt the product. From a sustainability perspective it appears that wheat is an excellent choice provided that transportation costs and emissions from shipping this product from India to not exceed the gains of switching to the new material. The vast majority of wheat straw is currently burned, and 90% of all paper products are made from wood. Being able to mitigate this waste will have direct implications for the sustainability of our forests. Recycling procedures for wheat paper are generally similar, though there is currently limited data regarding whether or not this new material would have any impact on UBC's own recycling facilities.

It is suggested that UBC adopt a limited trial run of this product in order to conduct more research into the implications of making a full switch. It is further recommended that UBC remain in dialogue with the supplier about their own sustainability initiatives in order to assure that that these decisions are in fact a step in the right direction

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## **1.0 Introduction**

The newspapers in Canada and the US account for 268,000 trees a year. Textbook in Ontario and Quebec alone account for 750,000 trees a year. There are large claims that wood fiber paper is produced using waste wood products yet 50% of the logged trees from the Boreal rainforest are used in paper production (Canopy, 2010, p. 5). It's noteworthy that Canada's Boreal forest is one of the largest carbon sinks and also contains 25% of the planet's freshwater (Canopy, 2010, p. 7). Logging down trees in such large numbers from the Boreal forests will have immense long term impacts on both the earth's atmosphere and its freshwater supply.

While some difficulties arise in measuring the direct carbon emission attributed to deforestation, it is clear from an environmental point of view that finding ways to lessen human impacts on the world's forests is desirable. One way of accomplishing this is the more efficient use of resources by substituting long-standing assumptions about what materials are 'best' for certain products.

That said, even if we are able to make a wiser choice of material, the paper industry is still faced with sustainability issues stemming from the bleaching, and general production processes required for standard paper products (The Clean Washington Center, 1997). As such, our research will be highly focused on the net sustainability effects of choosing alternative materials, namely agricultural wheat straw residue over the standard virgin wood materials that currently define the pulp and paper industry. We will determine if there is sufficient evidence in support of wheat paper to justify a large scale switch to the new product here at UBC.

## **2.0 Paper Characteristics**

Fibers larger in diameter and length result in better paper characteristics such as stiffness, tear, tensile, and fiber bonding. Fibers with such qualities are found in the internodes of the wheat straw. Another quality of the internodes that make it ideal as paper pulp is their lower silica concentration (The Clean Washington Center, 1997, p. 2.6, 2.7, 2.11). The major issue with using wheat fiber instead of wood fiber is the larger concentration of silica in the wheat straw. When cooking the wheat straw for pulp the silica will turn into glass and that is a huge problem. On the other hand, the silica can be removed prior to the wheat straw being cooked and many clean processes have been developed to do just that (Boychuk, 2008, p.11). Moreover, it seems that the morphology and chemical composition of wood, straw, or any other source of fiber may vary with location, genetics, and growth conditions (The Clean Washington Center, 1997, p. 2.1).

### **3.0 Current Applications of Wheat Paper**

The current application for the wheat paper is mainly in the areas where do not have rich wood resources, for example, China, India and some other Asia and Africa countries. There are some data here to proof how widely the wheat paper used back in China. Every year there is about 0.7 billion tons of wheat straw produced in China and about 30 million tons of wheat straw is used for papermaking. Wheat paper satisfies about  $\frac{1}{4}$  of total paper demand in China (Xinhua, 2012). Also, Chinese government is investing billions of dollars in R&D of the wheat manufacture.

In Canada, the most famous application is the showpiece June edition of the Royal Canadian Geographic Society's magazine, Canadian Geographic. In this application, about 14 tonnes of wood fibre was replaced by wheat straw. (CBC, 2008)

Some of the advantages for using these alternative fibers are:

1. Using wheat as a source of papermaking can reduce the pressure to harvest trees and forest.
2. For some countries where there do not have a lot of forest resources, some alternative sources may be collected after harvesting food crops could become an ideal alternative source for the papermaking. This will help decentralize and diversity the pulp and paper industry. This is also benefit for the local economics. (Inform Inc, 2008)
3. There are also some environmental benefits for using alternative source for papermaking.

### **4.0 Material and Resource Application**

The most interesting detail which applies to the comparison between wheat, and wood based paper products is the remarkable disparity in potential applications of each material. Currently, over 90% of all paper products use virgin wood as the pulping material (BC Forestry Climate Change Working Group, 2008). This is in stark contrast with the over 90% of wheat straw which is nothing more than a *residual agricultural waste product*. While a small portion of wheat straw is reserved for feed purposes (Sain, Panthapulakkal, 2004), there appears to be no industrial scale application of this by-product.

Wood products on the other hand are too numerous to list. The recent construction of the CIRS building on the UBC Vancouver campus has also demonstrated how the heavy use of wood products (including pine-beetle reclaimed wood) can be seen as a form of carbon sequestration initiative. These same arguments apply to the production of other long-lived wood products. While the recycling of paper may be a fairly large initiative today, there is no getting around the inevitable degradation of the plant fibers required for continued use in pulp products and paper (Inform Inc., 2008). So while the wood used in the construction industry may last for upward of 50 years, nearly 30% of an average landfill in the United States is filled with paper, and only 25% of post-consumer paper ends up being recycled (Hanson, 2006).

The obvious conclusion is that using higher durability wood products which have a long life span, compared to using the material for comparatively short-lived paper products is far more efficient in terms of carbon sequestration. Furthermore, low recycling rates indicate that even high quality wood fibers are not being used to their fullest extent when used as the base material for paper products. Introducing what is currently waste material as a useful, and beneficial resource, may in the long term be an excellent way to mitigate the stress on our forests.

## **5.0 Issues With Wheat Straw**

While the evidence generally points to wheat straw as a viable alternative material for paper production, there are a few issues which inhibit its wide scale adoption by the paper industry. The economics of using what is otherwise a waste material are superficially clear, if one is only concerned with the cost of materials. There is currently no market demand for wheat straw, and the wheat straw which is not used in feedstock is generally burned in open fields. This is a practice which contributes to air pollution and releases greenhouse gases (Sain, Panthapulakkal, 2004). Researchers have estimated that as much as 280 million tons of wheat residues are available in the U.S. alone which could be diverted for paper production (Smith, 1998). But this does not paint the whole picture.

Wood resources in forested areas are available year round. In contrast wheat is generally only harvested during a few short weeks once, or in some cases depending on climate, twice per year (Curtis, 2002). Moreover, depending on the current location of pulping plants, the transportation of waste wheat straw from the agricultural sites can become an issue, especially in Canada where our wheat fields spread across the west. This area is larger than most countries and significantly dilutes the concentration of pulping facilities in resource production areas. Carbon emissions, and cost implications of material transportation become more pronounced. As wheat paper becomes more widely adopted however, we can expect that some of these challenges will be addressed.

## **6.0 Transportation Considerations**

Transportation planning is an important part of the wood fiber flow chain in forestry. Large volumes and relatively long transport distances together with increasing fuel prices and environmental concerns make it more and more urgent to improve transportation planning. Transportation of wood fiber accounts for about 25 to 50 percent of the total delivered costs and this is likely to increase as fuel prices escalate (McDonald, 2001).

Since for every 1 pound of wet, living wood, about 55 to 60 percent is dry wood (that is, cells) and 40 to 45 percent is water (WoodWeb, 2012), the water contained in the cell lumen makes wood significantly heavier than wheat straw. A lot of production sites attempt to dry the wood prior to transportation; however, drying process consumes a lot of energy and often requires

significant amount of time. Moreover based on type of the wood, different methods and equipment is required to properly carry out the drying process. Wheat straw on the other hand can easily and quickly be dried in open air. In most production sites, wheat straw drying process only takes up to 3 days (Strumillo, 1986).

Drying process does not completely evaporates all the water in wood, as a result, even after drying process, dried wood is much heavier than dried wheat straw (Strumillo, 1986).

Wheat straw can easily be compressed and turned into different shapes. For instance in most production sites wheat straw is shaped and packed into round bales or small, square bales (The Straw Bale House, 2010). This flexibility both allows us to efficiently use the transportation space and simplifies the packing process of wheat straw. However, wood is often transported in its original shape as it requires a lot of energy to change the shape of the wood. It also requires special means of transportation and the space is often not efficiently used. Wheat straw is also transported using pipelines from production sites to refineries. Pipelines are convenient, fast and they also prevent material loss during the transportation (Luk, 2010).

In conclusion, as the transportation of wheat straw consumes less fuel and does not require special and expensive means of transportation; moreover, the drying process for wheat straw is significantly faster and cheaper than of wood's, it is recommended to use wheat straw as the primary source for paper and pulp production.

## **7.0 Recycling**

The recycling of 1 ton of paper saves about 17 trees, 3 cubic yards of landfill, 7000 gallons of water, and 42kWh of electricity (UBC Building Operations, 2009). Therefore, there is no doubt that the recycling process is of huge significance when considering a paper product. This is especially true at UBC who uses roughly 80 million sheets of paper per year (Sustain UBC). The recycling of paper products is conceptually basic with a series of preliminary steps carried out one after another. Improving the efficiency of the plant and the quality of the bi-product brings some complexity to these steps.

This is a brief description of the process: recycled paper is collected, categorized and then pulped in a tank containing chemicals and water that thus separates the fibers. It is then filtered to get rid of other waste products. In addition, it is deinked, usually by being spun in a cone-shaped container. Whitening agents are then used in the process to provide the paper with its color. The bi-product, (mainly water with a bit of fiber) is then pumped onto a vibrating screen which removes most of the water. This paper is then passed through a large series of large heated rollers so to achieve the correct thickness and moisture content. This paper is then formed into large rolls which can be divided and cut to be used as numerous paper products (Tai, Borromeo, & Tsoi, 2008, p. 3-12).

Therefore, there does not seem to be a huge difference between recycling wood fiber paper in comparison to wheat fiber paper. We previously discussed that the recycling process is



conceptually basic but there is a large complexity in making the process efficient. For this reason, although there doesn't seem to be a difference in between the respective recycling processes of each paper, there will of course be difficulties in attaining the most proficient processing line. For example, the rollers may need to have different characteristics or the amount of water and chemicals used in the pulp mixture during the cooking process might have to be different.

This should not be looked at as a pitfall but an opportunity. If we were to use wood fiber paper at UBC, we would be given the chance to carry out research on the recycling process associated with it. One of the hopes would be to decrease the use of chemicals in the cooking process making it less chemical intensive and thus not as environmentally hazardous. This would in turn increase the number of times the water can cycle through the system before it is associated as waste. These assumptions are based on the knowledge that in the production process of wheat paper many chemicals such as chlorine can be omitted. In addition, the whitening process of wheat paper is much more environmentally friendly than that used for conventional paper (bleaching). Economically, switching to wheat paper, seems cheaper in the long run because of the smaller quantity of chemicals required in the process. On the other hand, in the short-term, there may be need for new equipment and this along side with research required to optimize the plant will provide for excess cost.

## **8.0 Auditing And Other Observations**

The benefits of undertaking business deals with local companies include an a priori understanding of mandatory business practice in Canada. International companies may not be adherent to similar standards, and there should be procedures in place which mitigate the potential for abuse (especially when the goal of such an undertaking is to improve various sustainability metrics). As UBC has the potential to be a huge client for Royal Printers, we would suggest that they should be responsible for providing assurances that switching to their product will be a net positive in terms of moving forward with UBC sustainability goals.

## **9.0 Conclusion**

Wheat paper seems to be a feasible idea, and a fix to many of the environmental issues we are faced with today. Since it is being offered at the same price as the current 30% post-consumer paper UBC purchases, it almost seems like a no-brainer for UBC to switch. On the other hand, due to our location and our environmental standards, there are many other aspects that need to be taken into consideration. For example, the company we are purchasing the product from is no longer going to spend that income in Canada who is a large producer of wood fiber pulp. This will have huge economic implications. In addition, the paper is to be imported from India and this in itself has huge environmental impacts due to the emissions of the shipping method used.

From a materials standpoint, wide scale adoption of wheat based paper products has the potential to lessen the impact on our forests by taking advantage of a currently unused waste material, and promoting the long term use wood products for carbon sequestration purposes.

Further analysis shows that the recycling process may have to be altered in some ways to provide for a competent processing line. Keeping in mind all the off-putting aspects, the available data suggests a switch to wheat paper would provide a much greater net positive environmental impact.

We have come to the conclusion that a switch to wheat paper is a feasible idea and should be carried out, however all current applications of this product are on a small scale. Due to the lack of a rigorous research on the large scale use of the product, and that both paper types are purchased from the same provider, we suggest a UBC conduct a trial run. By incrementally implementing a switch to the new product, UBC will be able to carry out periodic research on the environmental, social, and economical impacts associated with wheat paper. Not only will this provide UBC with the ability to make a better long-term decision down the road, it will provide UBC with the chance to be the leader in the Canadian community. The research carried out at UBC will show the strength in its decision and thus provide the community with much enthusiasm to follow.

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