Canadian Export Assignment; Agricultural Drones/UAV's

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AGR 1110

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Introduction:

Nepal:

Nepal is an incredible country that is situated between China in the North, and India in the East. The country itself covers a total area of 147,181 sq. kilometers that is covered with tremendous geographic diversity for a small country. Three different land regions are classed out of the vast landscape, consisting of the Mountain region, Hill region and the Terai/Plains region. Each region has major geographic differences including altitude, land slopes and temperature. These three land regions are essentially what run the country of Nepal, as the majority of the land is used for agriculture which makes up approximately 36% of Nepal's GDP. For such a small country, the population is 27.8 million and the agriculture sector employs 66% of the total population (MOAD, 2014). Agriculture simply drives the economy of Nepal and so the development of agriculture is key.

Many families in Nepal depend on agriculture as their main source of income and food, so many grow their own food. However, not all land regions are ideal for farming. In the Mountain region, the cool-like temperature is most ideal for producing livestock like sheep and goats where the terrain can supply enough grass and forage for pasture. The Hill region varies in temperatures, and crops like rice and maize in the summer, and fruits, vegetables and flowers, are produced in the winter on hillside terraces. The cooler varying temperatures of the hill region makes growing the same crops all year round difficult, so usually different crops are planted and harvested depending on season (Ricebean Network, 2005). The Plains region is the flattest part of the country where the vast majority of agriculture takes place. Temperature in the Plains region often gets to

over 40 degrees Celsius in the summer and the subtropical climate allows for growing crops year round (Trek for Nepal, 2014). Major crops of the Plains are rice, barley, wheat and oilseeds (New Agriculturalist, 2009).

Canada:

Canada is a large country located in the most northern part of the North American continent. It is home to approximately 34.3 billion people and the country covers a total land area of 9,093,507 sq. kilometers making Canada the second largest country in the world (Infoplease, 2014). Canada covers a vast majority of climates and land regions across the 10 provinces and three territories, with agriculture being a huge contributor of the land east to west. The prairies consist of some of the flattest land regions in Canada where many crops are grown including canola, wheat, oats and flax, while Alberta is mainly know for beef cattle production. Moving east, Quebec and Ontario are known for the production of soybean and corn, as well as dairy operations. Canada also has a fair amount of fish farms on the coastal provinces of British Columbia, New Brunswick and Newfoundland.

Canada's agricultural contribution accounts for 6.7% of the GDP and employs 5.2% of the total population. The United States is Canada's number one export partner and China is now number two, for products of livestock and grains (AAFS, 2014). The developed country makes Canada the 6th largest agriculture country for exports in the world and technological advancements are making the farming industry even more productive then ever before (Maps of the World, 2014).

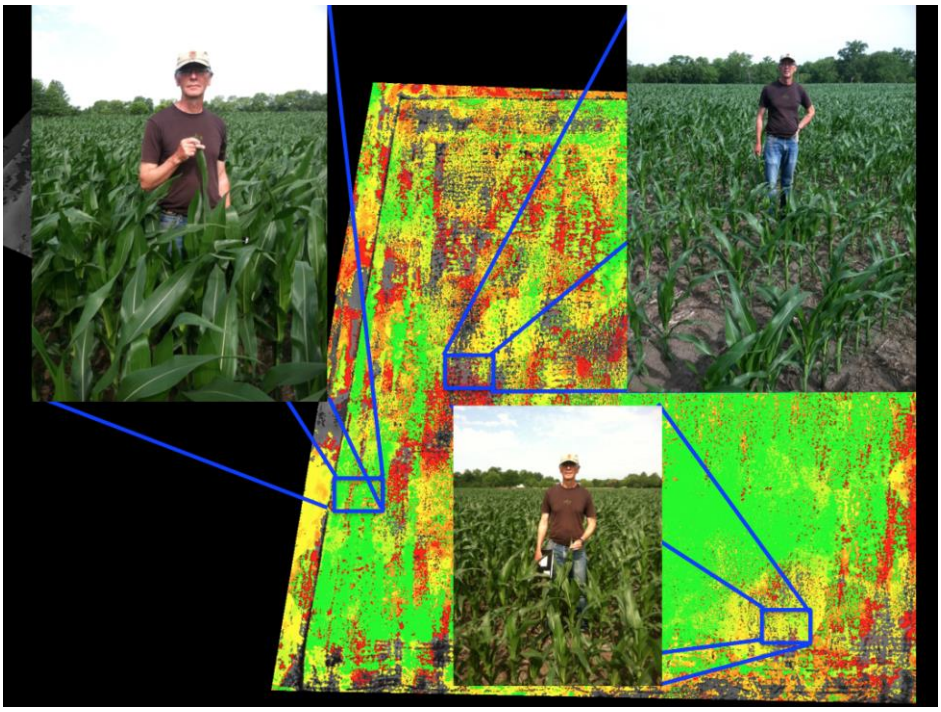
Part I: Product Info

Modern day technology has skyrocketed, introducing a new era of profit and productivity to businesses around the world. Technology is the 3rd most thriving industry in Canada, behind agriculture that is number one (Groff, 2013). When looking at technology from an agricultural viewpoint, so much has changed to help farmers increase yields, expand to run large scale operations, and most of all be sustainable to grow more food to meet human needs. There are an incredible amount of technologies out there to help every aspect of the agriculture sector, including robotic milking systems, automated feeding systems and one in particular are agricultural drones. Precision agriculture has become a very popular topic lately.

Precision agriculture is essentially using the latest technology such as GPS that are used on agricultural equipment that together enable farmers to use electronic guidance to direct equipment more accurately. This precise positioning of equipment allows farmers to save money when applying chemicals to crops, as well as saving in fuel costs. This method of agriculture, however, is not only for chemical application. Precision agriculture affects the whole function of an operation as it allows for yield monitoring, variable spraying, guidance systems and records and analysis of crops just to name a few (Goddard, 2014). Despite these methods being extremely useful, precision agriculture has taken it to the next level that has literally taken flight in farmer's fields.

Drones, or unmanned aerial vehicles (UAV's), are essentially flying robots that are equipped with GPS monitors to take high-resolution images and videos while programmed on a mapped route over one or a series of fields. These images can then be used to manage fields that may be affected by crop stress, such as drought and insect

infestation, as well as measuring the greenness and photosynthetic activity (Stoneman, 2014). UAV's come with a wide variety of shapes and sizes as well as camera types to capture different angles, and views of specific targets, which in this case are crops. Certain cameras that are equipped on UAV's can capture different image types including multi-spectral images, visible and infared images, thermal images and normalized difference vegetation index (NDVI) images (Chris Ozmun, Personal Communication, November 5th, 2014).



(Figure 1.0) The picture represents a photo taken by a UAV using NDVI imagery in a 40-acre corn field. This camera technology shows the difference in growth stages that may not be noticeable from ground. This allows farmers to apply more specific fertilizer in areas that are needed, and less that aren't (Grady, July 9th, 2014). Retrieved from: https://www.sparkfun.com/news/1537

In Canada, agriculture has largely become dependant on commercial fertilizers and genetically modified seeds. This means that many macronutrients and micronutrients

are needed to be applied to the soil and the crop to ensure boosted yields and productivity. This conventional method of agriculture had Canadian producers applying commercial fertilizers to 61.6 millions acres of land, although much of it is not needed and simply wasted (Stats Canada, 2010). As shown in **(Figure 1.0)** there are parts of the corn field that are not in need of fertilizers, perhaps because of the terrain where it was at the bottom of a small hill in the field where there was a build of nutrients in the soil. In other parts of the field, it was easy to determine there needed to be more fertilizer applied to help uniform the crop and increase the yield.

UAV's in Canada, and across the world are simply taking these matters and using the air borne technology to detect these problems that farmers have in their fields. By analyzing and contributing to these methods of precision agriculture, crop producers can save immensely when it comes to the cost of fertilizer and fuel (Redmond, 2014). Not only are UAV's practical for the use of fertilizer application, but also for visual mapping of land, detecting crop health and also for the use when harvesting your crops.

UAV's come in a variety of different shapes and sizes, depending on preference and budget. There are many manufacturers world wide of UAV's, however there are only few in Canada. A few major players in the precision agriculture sector include that of a company based out of Hammonds Plains, Nova Scotia is SkySquirrel Technologies, and another from Saskatoon, Saskatchewan is DranganFly Innovations Inc. These two companies both provide excellent products, however accessible information was only successful with DraganFly Innovations.

DraganFly Innovations:

Located out of Saskatoon, Saskatchewan, DraganFly Innovations is a Canadian manufacturer of UAV's for the use of public safety, aerial photography, industrial inspection, education and of course agriculture. This unique company has made its way from the ground up, building everything from hardware design, circuit boards, and software systems to the lightweight carbon fibre design. All of this has made its way into the industry off of simple designs that are precise and well engineered since 1998 (Chris Ozmun, Personal Communications, November 5th, 2014).

Draganflyer Guardian Mapping Package:	**Draganflyer X4-P Mapping Package:**	**Draganflyer X4-ES Mapping Package:**
$12,495.00 USD	$21,495.00 USD	$30,495.00 USD
▪ 420 gram payload capacity ▪ Carbon Fiber airframe ▪ GPS, Alt hold & Return Home ▪ Digital video & quick release Compact and Back-Packable	▪ 800 gram payload capacity ▪ Folding Carbon Fiber frame ▪ GPS, Alt hold & Return Home ▪ Digital video downlink ▪ Tool-less removable CF props	▪ 800 gram payload capacity ▪ Ultraportable folding CF frame ▪ GPS, Alt hold & Return Home ▪ Digital video & quick release Tool-less removable CF props

(Figure 2.0) This table shows the comparisons of popular products sold from DranganFly Innovations in the use of agriculture. Prices range variably as UAV's have different compatibility factors to make them more precise, lightweight and easy to use (Chris Ozmun, Personal Communications, November 5th, 2014). Retrieved from: http://www.draganfly.com/industrial/products.php

Competitive Products from Other Countries:

DraganFly Innovations is an incredibly reliable product that has manufactured many UAV's that are built to last. Unfortunately with this great product, comes a large price tag for not only Canadians, but also other buyers around the world. One other manufacturer of UAV's is a company called Shenzhen X-Viki Technology Co. Ltd. Based out of Guangdong, China, the Octocoptor BAT X900 is made out of carbon fibre material like that of DraganFly's products, yet costs only $1,499.00 USD (Alibaba, 2014). Comparing the Octocoptor BAT X900 to that of DraganFly's Guardian, which is $12,495.00 USD, is much cheaper while both contain essentially the same basics of structure, and only differencing slightly in technology with image variety and quality.

In Canada, Unmanned Aerial Vehicles are becoming more and more popular because of their wide range of applications, however, a Special Flight Operators Certificate is needed in order to use it. A SFOC is needed through Transport Canada to ensure safe and responsible manners when flying UAV's. The standard fee for an uncomplicated SFOC is $1,300.00, and for further complex applications costs more (CCUVS, 2014).

UAV's also provide huge environmental benefits when determining the applications of fertilizer usage. Often times, farmers purchase large amounts of fertilizers to apply on the whole field, but as mentioned earlier, some areas of the field may not need as much or any fertilizer at all because it already has a sufficient amount in the soil. This detection can ultimately reduce the amount of soil saturation of these macronutrients or micronutrients, and therefore decrease and even eliminate unwanted run-off of

potential chemicals and nutrients such as nitrogen and phosphorus (USGS, 2014). In the end farmers are saving money by reducing the amount of fertilizer application to their fields and also reducing the potential harmful risk to the environment of chemical run-off.

Part II: UAV's in Nepal

For a small country Nepal consist of various land regions and terrain as mentioned in the introduction section. Agriculture in Nepal accounts for a very large proportion of Nepalese workforce and GDP for the country. This is made possible because of the three land regions that provide much of the country with various types of food including cereal crops, fruits and vegetables and livestock (Sharma, 2014). In Nepal, technological advancements for agriculture are not nearly as developed when comparing to farming in Canada. Producers in Nepal use simple tools like plows, spades, sickles, hammers, axes and chisels. Oxen are used to plow the fields, but hardly any machinery tools are used because it is generally too expensive, and difficult to use in the Hill regions of Nepal. Chemical fertilizers are now starting to become more familiar in Nepal, however the main source for applying micronutrients to the soils is through cattle dung and organic decomposed material from leaves, and animal-fodder (CFFN, 2014).

The technologies that UAV's provide can be more than effective in expanding the farming industry in Nepal, even though it is just starting to become a land-mark in Canada. The intensive landscape that is used for farming can be managed on such an efficient scale that it would save Nepalese farm labourers treacherous work, especially in the Hill regions. Because of a drones capability to fly high in the air, Nepalese farmers would be able to map their plots of land, either in the Hills region or Plains region, and determine how their crops are growing before applying any fertilizer on them. This would save farmers from walking through the land checking crops, as well as deciding what part of the crop is lacking more fertilizer than others. UAV's can also be an effective tool that

benefits the environment as the differentiating climate on crops planted can be detected from UAV's, thus viewing the growing conditions (Stoneman, 2014). Nepal is a favourable country that farms on hillside terraces and therefore are sometimes under threat of eroding land. UAV's could detect this problem where it otherwise might not be noticed by Nepalese farmers and could save the negative impact on the land.

Shipping Logistics From Canada:

Shipping of UAV's from Canada definitely is not an easy task, because Nepal is a land locked country between China and India, therefore making accessibility to shipping ports on the ocean quite difficult. Because UAV's are generally lightweight and foldable, they can be packed in a small carrier kit of approximately 30lbs. Air shipment of this DraganFly product would leave from Saskatoon International Airport in Saskatchewan via FedEx and would arrive in Tribhuvan International Airport just outside of Kathmandu, Nepal. The cost of shipping a UAV from Saskatchewan to Nepal is approximately $700.00. This number was retrieved using an online calculator in which I had estimated the total product to weigh about 30 lbs due to the UAV, packaging, electronics and software to run in, and a heavy duty case to carry it all in (FedEx, 2014). Once the product is in Nepal, it can then be distributed through postal services to the particular buyer.

Shipping Logistics From China:

A second shipping logistic of the Shenzhen X-Viki Technology Co. Ltd is shipping it via FedEx air to compare prices of that from Canada. The UAV would be

shipped from Shenzhen Bao'an International Airport to Tribhuvan International Airport in Nepal. The cost of air shipment of this product is approximately $1,200.00 using the same information from the online calculator as from Canada (FedEx, 2014). The cost of flying the product from China to Nepal is more expensive then shipping from Canada, but the high shipping costs from China still beats the overall price of the UAV itself by $10,476.70. Ground shipment from China to Nepal is $610.00, so this would be the cheapest alternative overall (FedEx, 2014).

Potential Buyers of a DranganFly UAV:

Finding a company that deals with both agriculture and technology is difficult, especially because Nepal in general is not entirely technologically advanced in agriculture. One method of promoting the use of UAV's could be done through Tribhuvan University in Nepal. "Agricultural Engineering Division under Nepal Agricultural Research Council, Agricultural Engineering Directorate under department of Agriculture and Purbanchal Campus, Institute of Engineering under Tribhuvan University are major research, extension and education institutions related to agriculture mechanization in Nepal respectively" (Shrestha, 2013). Interacting with the university could hopefully expand the use of UAV products to farmers, or in a more realistic and economic sense, to villages. If a village of farmers came together to purchase a UAV, it could not only benefit the production of crops for just one farmer, but many.

Drawbacks of UAV's to Nepal:

Even though UAV's are an excellent idea to Canadian crop producers who work on hundreds and even thousands of acres of land, UAV's may be a difficult product to export to Nepal. Almost all of the agricultural practices used in Nepal are done by hand, and no technology is involved. Almost all Nepalese farmers have less than 1 hectare of land, and subsistence farming is huge. The majority of the people only grow enough food to live on, and nothing more to sell (IFAD, 2014). This makes selling a UAV to Nepal very difficult as there would be no buyers because it is too expense and also too extreme to use on such small plots of land for one farmer.

Other uses for UAV's in Nepal:

Nepal is home to the world's highest mountain, which attracts explorers and trekkers all around the world to test themselves against the snowy mass of rock; Mt. Everest. This expedition that people risk their lives to take part in has killed 248 people from 1924 to 2013. The main causes of these deaths were falls, avalanches, exposure to the extremely cold temperature and altitude sickness, where almost all of the bodies are still on the mountain (Arnette, 2014). UAV's could be an excellent tool used in search and rescue to lower the amount of deaths on the mountain. UAV's could constantly be monitoring certain parts of the mountain and also follow/check up on climbers to make sure no danger is present. This technology could notify for help and reduce the risk of a potential death.

Another use for UAV's in Nepal is to sell them to the Tribhuvan University where there is a program called the Institute of Science and Technology (Tribhuvan University,

2014). Here, students could learn how technology is used to make drones, and go out in the field to use them to learn practical knowledge of this modern day technology. With this newly introduced information being taught to university students in Nepal, studies can be done using the UAV on agricultural sites, much like the common use for UAV's in Canada. If new practices for introducing technology are brought into countries where there are a lack of advancements and knowledge about technologies, it could really help develop the country, as well as many industries that help contribute to the GDP.

In Nepal, because of the intensive landscape, UAV's would overall help manage farms and increase crop yields at the same time. This type of technology is something that like Canada, will benefit the environment, and introduce a new kind of technology to Nepal to hopefully expand its many uses. Despite its high costs, alternatives can be found to assist in funding for a cheaper model from a near by country, such as that of Shenzhen X-Viki Technology in China where the costs are much less. Introducing UAV's into Nepal can be done if not one Nepalese contributes, but if many contribute in purchasing one UAV to access their great potential and various uses.

Critical Summary:

As a critical summary and recommendation to the Canadian producer of DraganFly Innovations, and other manufacturers like SkySquirrel Technologies, is to work on a product that is more inexpensive. As a consumer, it is difficult enough to be able to afford this type of technology in the first place to actually benefit and make money off of it in the long run. Even though using UAV's are beneficial to cost savings

each year to farmers, it will be minimal and would still take several years to actually make a return off of using the product. In terms of making a more inexpensive product, I believe companies who make expensive products in the uses for agriculture need to be more open minded and think outside the box. This for instance, takes in a situation like Nepal. Nepal is 'late bloomer' of technology who deeply relies on agriculture in a way of sustaining the economy, as well as surviving everyday. Producers like DraganFly Innovations should take into account that there are counties that could deeply benefit from the use of their product, even though they simply cannot afford it. Making UAV's less expensive could enhance the chances of making the exporting product more realistic and beneficial to both countries of Canada and Nepal, as both are largely based off of agricultural industries. DraganFly Innovations can simply start by building some products that use cheaper plastics instead of building out of carbon fibre for structure, and equip each UAV with less expensive camera equipment. With doing this, the cost of the product can significantly be lowered and keep the use of operations simple so that counties like Nepal can use it with ease. Making a product that is more financially reasonable to not only Canadians, but also to potential buyers around the world will make DraganFly's UAV competitive to companies such as Shenzhen X-Viki Technologies in China where their costs of UAV's are significantly lower. I believe if more Canadian products were built to suit many different countries around the world for beneficial uses, companies in Canada would benefit greatly and export more products.

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