

# Export Potential of Manual Potato Seed Cutters to Nepal

AGR 1110  
December 1, 2015

## **Introduction**

As Nepal is the destination for the potential export product, a brief summary highlighting important facts about the country will be helpful in order to evaluate the usefulness and feasibility of the product.

Nepal is a landlocked country located in South Asia located between the two giants India and China (CIA, 2015). The nation faces many challenges due to a variety of factors. In 2014, Nepal's Gross Domestic Product (GDP) was \$67.14 billion USD and the GDP per capita was \$2400, thereby classifying it as a very poor nation (CIA, 2015). The literacy rate is low at 65.9%, the energy sector is severely underdeveloped, and about half of the nation's roadways are unpaved (CIA, 2015).

It is a largely agrarian society with 28.8% of its land used for agriculture and 75% of its population employed in the agricultural sector (CIA, 2015). Nepal is a small nation with an area of 147,181 square km (CIA, 2015). Despite its small size, Nepal is blessed or cursed, depending on whom you ask, with rich, geographic diversity. The diverse landscape influences land use and dictate three agro-ecological zones: Terai, Hills, and Mountain zones (Pariyar, 2008). The climate varies in the agro-ecological zones ranging from tropical, subtropical and temperate (FAO, 2001). This allows Nepal to have a high degree of crop diversification (FAO, 2001).

## **Part I: Product Information**

Because the export potential product is a Manual Potato Seed Cutter and the material it processes is the potato, it is important to provide background information on the potato.

The potato (*Solanum tuberosum* L.) is an important crop and its hardiness allows it to grow in diverse climatological regions worldwide (Struik & Wiersema, 1999). Interestingly, potato production has increased in many developing countries since the 1960s (Struik & Wiersema, 1999). The potato is considered a staple Nepalese crop and has the potential to address food insecurity within the country (Timsina et al., 2013). Compared to the other major crops including rice, maize, and wheat, potato production is competitive and promising (**Table 1**).

**Table 1:** Potato Industry Rankings (NARC, 2007)

Category	Rank	Measure
Area Grown	5	185,000 ha
Production	2	2.5 million tons
Productivity	1	13.6 t/ha

Most potato production occurs asexually through planting the seed tuber portion of the potato plant (Struik & Wiersema, 1999). Each eye on the tuber has the potential to emerge into a new plant though it does not mean that each eye automatically becomes a new stem (Struik & Wiersema, 1999). Plants grow best if their stems are uniformly separated (Struik & Wiersema, 1999). Therefore, rather than planting the whole tuber, seed pieces should be cut to control spatial arrangement and in turn maximize the number of new plants in the field (Struik & Wiersema, 1999). Other factors such as type of cultivar can influence yield (Nielsen et al., 1989). Still, the manipulation of spatial arrangement and seed piece size alone can increase yields (**Table 2**).

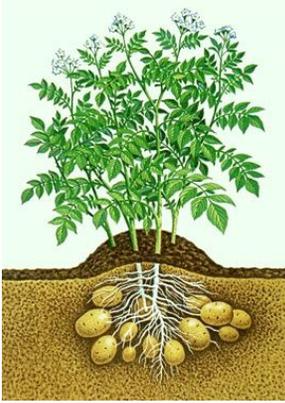
**Figure 1:** Potato Seed Production Cycle from Tubers (Simplified)



Step 1: Cut Seed Pieces

Source:

<http://lubbockonline.com/sites/default/files/imagecache/superphoto/13158915.jpg>



Step 2: Potato plant forms stems emerging from eyes

Source: <http://s.hswstatic.com/gif/willow/potato-info0.gif>

**Table 2:** The effect of seed size on yield (Struik & Wiersema, 1999)

Seed size (mm)	Number of stems per seed (estimate)	Average Yield (tonnes/ha)
35	2.5	40
45	4	30
55	5	20

In Nepal, the average potato yield is 13.6 tonnes/ha (NARC, 2007). By manipulating simple factors such as seed size, perhaps yield can be increased.

### **Technology Description**

In Canada, potato production occurs on an industrial scale. The average Canadian potato farm was 110 hectares in 2011 and continues to grow (Government of Canada, 2015). During the preliminary product search stage, personal contact was made with experts from various Canadian potato associations. According to Deb Hart, Seed Coordinator from the Potato Growers of Alberta, it is the standard for Canadian potato producers i.e. farmers to cut seed using big, industrial, mechanized potato seed cutters (Deb Hart, personal communication, October 28, 2015). When asked about manual powered machinery, Hart said it was obsolete (Deb Hart, personal communication, October 28, 2015). Considering the average size of Canadian potato farms, that makes sense. Kevin MacIsaac, General Manager of the United Potato Growers of Canada in Prince Edward Island, said Canadian producers use one of two kinds of seed cutters:

Milestone from Idaho and Betterbilt from Utah (Kevin MacIsaac, personal communication, Nov. 3, 2015). However, Milestone is said to have increased market share over the past five years (Kevin MacIsaac, personal communication, Nov. 3, 2015). A direct quote from the manufacturer Milestone lists the base model 36-D at \$84,213 USD, not including shipping and fuel inputs (Milestone sales representative, Nov. 3, 2015).

**Figure 2:** Milestone Potato Seed Cutter Model 36-D



Source: <http://www.milestone-equipment.com/cutters-and-treaters>

In comparison, the average farm size in Nepal is 0.8 hectares (FAO, 2010). The vast difference in scale of production between the two nations in part explains the huge gap in technology. A smaller scale technology appropriate for Nepal is unavailable in Canada due to the scale factor alone. Also, Canadian producers have a large energy input which is not available to Nepal due to a lack of energy infrastructure. The low energy inputs in Nepal must be taken into consideration. In the meantime, scaling up potato seed production will require human energy inputs as the next best thing. However, a smaller scale potato seed cutting technology excluding the hand cutting method is virtually obsolete in the North American sector. Smaller scale machines are available of the

manual variety but such machines are now artifacts for which manufacturing has ceased (Figures 3 & 4).



**Figure 3:** Potato Set Cutter circa 1890s

Source: <http://artefactspei.weebly.com/potato-cutter.html>



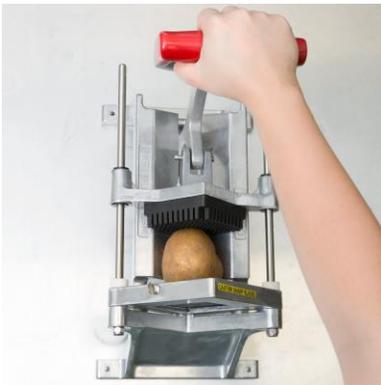
**Figure 4:** John Deere Potato Cutter

Source: <http://www.farmcollector.com/equipment/rusty-relic-is-a-potato-cutter.aspx>

### **Product/Machinery required**

Though typically not used to cut potato seeds, a French Fry/Vegetable Cutter could be used as an alternative to mechanize seed cutting which is typically done by hand using a knife. Since the product is not optimized for the desired purpose of cutting potato seeds, contacting a top Canadian food equipment company sufficed in examining product qualities. The French Fry/Vegetable Cutter is the closest technology to seed cutting in Canada that is not on an industrial scale. Although seemingly far off from being an agricultural product, the French Fry Cutter is a small and compact yet powerful manual machine.

Imagine the typical French fry. It is thin and does not look like a typical potato seed cutting. Most French Fry Cutters do not have adjustable blades nor have blades that would leave enough surface area of the potato skin exposed. It is important to leave a sizeable portion of the skin exposed because that is where the eyes are. The Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® has adjustable blades, most notably a 4-cut blade that is the closest cut to resembling the desired potato seed shape (**Figure 5 & 6**). By pulling down on the lever, the device cuts the potato in one step. It is recommended that a bucket is underneath to catch the cuttings. It must be noted that the resulting wedge shape may not be perfect and further cutting might need to be done by hand to produce the dimensions of a high-yielding seed (Refer to Table 2 for seed sizes).



**Figure 5:** Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath®

Source: <http://www.webstaurantstore.com/vollrath-redco-15016-instacut-3-5-1-4-fruit-and-vegetable-dicer-wall-mount/92215016.html>

**Figure 6a&b:** 4-cut adjustable blade for Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath®



Source: <http://www.webstaurantstore.com/vollrath-redco-15065-4-section-wedge-replacement-blade-assembly-for-vollrath-redco-3-5-fruit-and-vegetable-wedger/92215065.html>

Despite not producing the perfect shaped seed, the product is user-friendly as it cuts three times faster compared to by hand and has a sturdy aluminum and stainless steel construction (Vollrath, 2012). Most importantly if it is wall-mounted, it works with the force of gravity.

**Company Info**

Although the products by Vollrath® are made in America, Hendrix is one of the Canadian companies that distributes it. Hendrix, a restaurant equipment and supplies distributor, has nine brick and mortar stores nationwide in addition to having an e-commerce website (Hendrix, 2015).

**Table 3:** Hendrix Contact Information

<b>Website</b>	<b>Phone Number</b>
<a href="http://www.hendrixequip.com/">http://www.hendrixequip.com/</a>	1-844-656-0303

**Product Cost**

The cost of a single unit of the Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® is quite steep at \$481.22 but purchasing in bulk with Hendrix brings considerable discounts.

**Table 4:** Pricing for Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® (Hendrix Sales Representative, personal communication, November 6, 2015)

<b>Number of Units</b>	<b>Price per unit (taxes included)</b>
1-2	\$481.22
3-9	\$333.46
9+	\$277.90

**Health or nutritional information associated with product**

The growth of a potato plant from a potato seed eventually leads to multiple tubers that can be used for consumption. Though not a complete food, potatoes complement other foods because they have high quality protein, are rich in nitrogen

among other vitamins and trace elements (International Potato Center, 1984; Horton, 1987). Though rice is still the staple crop in Nepal, the potato ranks second and its demand and consumption is rising (FAO, 2008a).

### **Benefits to Canada**

This section will be divided into two parts due to the real world product example not suiting the desired action completely: 1) Benefits to Canada for selling the existing French Fry Cutter as a Seed Cutter, 2) Benefits to Canada for creating an innovative product

#### **1) Benefits to Canada for selling the existing French Fry Cutter as a Seed Cutter**

##### **Increased Sales**

Although the actual sales figure will depend greatly on which market(s) of Nepalese consumers actually end up buying and then using the Fry Cutter as a Potato Seed Cutter, the Canadian company Hendrix will enjoy increased profit from an exciting, new international opportunity. Over the years, Hendrix has developed market share in the restaurant equipment sector by building up its consumer base in diverse target markets (Hendrix, 2015).

##### **Increased Activity in Other Sectors**

Other industries such as transportation logistics will be involved in making this trade connection between Canada and Nepal work.

#### **2) Benefits to Canada for creating an innovative product**

##### **Potential New Market Opportunity**

Although the Fry Cutter is the export potential product of this paper, it would not be optimal to be used as a Potato Seed Cutter. However, Canada has great capabilities as

a developed and industrialized nation to make a specialized product that could create new market opportunity. Canada has rich capacity in Research and Development (R&D) including machinery design and is strong in the key segment of agribusiness machinery (Government of Canada, 2014). Therefore a low-tech Potato Seed Cutter should not be too much of a challenge to customize.

### **Patent/intellectual property constraints**

If a Canadian company does decide to create a manual potato seed cutter intended and customized for lower scale production, there may be patent or intellectual property constraints on machines with similar mechanisms such as French Fry Cutters. However, the simple manual mechanism based on gravity helping to cut the potato should be considered nothing more than a simple engineering project. The opportunity and intellectual knowledge is there. An entrepreneurial spirit simply has to take charge.

## **Part II: Export Potential to Nepal**

### **Transportation logistics**

Hendrix has three distribution warehouses in Canada located in Abbotsford, BC, Edmonton, AB and Brockville, ON (Hendrix sales representative, personal communication, Nov. 5, 2015). Abbotsford is near Vancouver and Brockville is near Toronto so the two locations are close to major Canadian trading port cities. Two transportation quotes will reflect shipping from the Abbotsford and Brockville warehouses. Because the cost per product unit is most cost effective when purchasing 10 or more units (Table 4), all transportation quotes will reflect this. First, FedEx will pick up from the warehouse and deliver the package to the appropriate trading port city's International Airport. From there, the Canadian freight company A1 Freight Forwarding

will fly the units to Kathmandu, Nepal (**Tables 5**). Finally, once the units reach Kathmandu, they will be driven to the final consumers via trucks.

**Table 5:** Quotes to ship 10 units of the Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® from Canada (Brock, ON/Abbotsford, BC) to Kathmandu, Nepal via 1 business day – FedEx Ground (FedEx, 2015) & Air Freight – General Cargo Shipment (A1 Forwarding, 2015)

\*Note: Prices include taxes

	<b>Brockville, ON</b>	<b>Abbotsford, BC</b>
<b>Chargeable Weight</b>	54.36 kg	54.36 kg
<b>Product Cost</b>	\$2779.00	\$2779.00
<b>FedEx (Shipping Cost)</b>	\$88.26	\$71.05
<b>A1 Forwarding (Shipping Cost)</b>	\$379.29	\$420.06
<b>Product + Shipping Costs</b>	\$3246.55	\$3270.11
<b>Cost Per Unit</b>	<b><u>\$324.66</u></b>	<b><u>\$327.01</u></b>

### **Cost analysis in the Nepalese context**

After international shipping costs, the approximate price of an individual French Fry Cutter unit is \$330 CAD (Figure 5). In Nepal, where the currency is the Nepalese Rupee (NPR), the price per unit is approximately 26,315 NPR (Xe, 2015). This price has not yet been marketed up to the Nepalese retail price. The 2014 GDP per capita of Nepal was \$2400 USD (CIA, 2015). If converted, the GDP per capita is approximately 256,267 NPR (Xe, 2015). To get an idea of the cost of this product, if an individual consumer were to purchase one French Fry Cutter unit, he or she would be spending about 10% of his or her annual income. Consumer markets will be discussed later.

### **Benefits to the importing nation**

This section will focus on three of SAK Nepal’s identified priorities: 1) Scaling up, 2) Low input access, and 3) Reducing female drudgery (SAK Nepal, 2015).

#### **1) Scaling up - Potato Industry is Promising**

In comparison to other staple crops, potatoes are very productive (Figure 1). However, on a global scale Nepal's potato yield is quite low (FAO, 2008b). Though potatoes grow in all parts of Nepal (FAO, 2008a), most potatoes are grown in the Hills (Mountain) region (Schulz et al., 1998). 60% of the population lives in the Middle Hills (Mountain) region (Pariyar, 2008). Food security in part can be targeted through directing focus and scaling up on a productive crop that is well suited to an area where most of the population resides.

The most popular method for potato propagation in Nepal is by using seed tubers (Schulz et al., 1998). Traditionally, farmers have made seed potatoes from cutting up whole potatoes (Rhoades, 1985). However extreme methods have been used to maximize seed in a field such as planting very small cut seed pieces with one eye (Adhikari, 2005). Methods like these are not productive (Adhikari, 2005). Providing farmers with tools such as seed cutters could help to scale up production. Seed size alone can affect yields (refer to Table 2). The Seed Cutter would consistently produce uniformly shaped seeds would be very beneficial for farmers.

Nepalese agriculture is largely subsistence agriculture. The next level up from subsistence farming for potatoes is to sell the surplus in the marketplace (Askew, 2001). The potato markets in developed countries differs from developing countries. In developed countries, the markets are described as being 'mature' so profit is derived from making secondary products from the potato material in order to add value to the farm gate price (Askew, 2001). Though entrepreneurialism may not be the primary focus of subsistence farmers in developing countries, the mere result of producing crop surpluses

increases the possibility of industries popping up to produce secondary products for added value.

## 2) Low Input Access – Nepalese farmers need more technology

Scaling up agricultural production of any kind requires moving away from manual labor and implementing machinery. It is almost a given that Canadian agriculture is powered by machinery that runs on electricity on that basis that it is a developed country (Dyers & Desjardins, 2006). However, developing nations like Nepal do not have that luxury. The Nepal Electricity Authority (NEA), Nepal's sole provider of electricity, only reaches 14% of the population (Sovacool et al., 2013). As of 2014, 82% of the population was rural (World Bank, 2015) and 75% works in agriculture (CIA, 2015). Agriculture in Nepal is primarily powered by human labor especially in remote areas (Sovacool et al., 2013). Therefore, working in agriculture is very labor intensive. Considering the main source of electricity is hydroelectricity (92.5% of electric capacity), followed by fossil fuels (7.5% of electric capacity) with other sources being severely underdeveloped (CIA, 2015), it is unlikely that farmers without access will gain access any time soon.

Electricity is not readily available in remote regions in the Hills and even parts of the Terai (UN, 2009). Because this is the case, farm mechanization needs to occur by using improved manual tools (UN, 2009). Taking it a step further, it is even better if these improved tools are mechanized. If potato production and other crop production are to rise above a subsistence level, new tools need to be introduced to cut down on labor-intensive and time-consuming tasks (IRRI, 1986). Because seed production is an important step in potato production, the introduction of a manual potato seed cutter will give farmers an additional tool input.

However, even though machinery is supposed to make farmers' lives easier, it should not displace their livelihoods (IRRI, 1986). This is especially relevant for nations with a high percentage of its population employed in the agricultural sector. A small implement such as a Potato Seed Cutter is an accessory tool so it is unlikely to displace any jobs.

### 3) Reduce Female Drudgery – Women need tools to reduce drudgery

Nepalese farms mostly run by women due to the migration of large numbers of men out of farming communities (i.e. cities or abroad) in search for employment outside of the agricultural sector (UN, 2009). Because of this, there may be labor shortages in some areas. Still, agricultural labor is gendered (Abdulai & Regmi, 2000). Women are responsible for a wide variety of farming activities, except for plowing which is in the man's domain (Hertzog, 2011). These activities include preparing land for cultivation, seed preparation and planting, weeding and harvesting (Hertzog, 2011). Most of these tasks are tedious, labor-intensive and time-consuming but the adoption of machine mechanization may reduce female drudgery in those areas (UN, 2009). Even though preparing seeds is not a daily activity, the use of a seed cutter during sowing season could cut down on the women's workload therefore allowing them to focusing on their many other activities.

## **Challenges**

### Seed Quality

Potato tubers have the tendency to acquire and pass on disease as each generation passes (Schulz et al., 1998). This is because each previous generation will have been exposed to various pests and pathogens in the growing field (Rabinowitch & Levy,

2001). Diseased seeds reduce yield as well as quality of subsequent tubers (Rabinowitch & Levy, 2001). It is therefore very important to ensure tubers are in good health before planting (Struik & Wiersema, 1999).

However, in many developing countries, it is not uncommon for farmers to use degraded tubers as seeds (Wale et al., 2008). Nepal is no exception where farmers often have no choice but to plant unhealthy seeds cut from degraded tubers due to the prices of disease-free potato stocks being unaffordable and inaccessible (Schulz et al., 1998). Though a seed cutter would increase the number of seeds, it will not increase productivity if the tubers are degraded to begin with.

#### Product May Not Be Optimized for Purpose

Although the Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® is being proposed to be used as a Potato Seed Cutter, its mechanism is not optimized to cut all types of potatoes into potato seeds. It does not matter if the machine can cut three times faster than by hand (Vollrath, 2015) if the resultant shape is wrong. It will take additional time inputs to cut the cut shape into the right shape.

#### **Potential Nepalese buyers**

##### Seed Companies

SAK Nepal is already working with the Nepalese seed company Anamolbiu. Anamolbiu produces potato seeds in addition to other crops (Anamolbiu, 2015). Since the company works with seeds in a much larger capacity than smallholder farms, a Potato Seed Cutter may be suit their needs.

##### Seed Merchants

Seed merchants make a living by selling pre-sprouted seed tubers to farmers (Rhoades, 1985). By producing the amount of seeds at a faster rate using a Potato Seed Cutter, the business may be able to expand.

### Communities

Although the cost of one unit of Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath® would be too steep for one smallholder farm to purchase, a village or community could come together and purchase one unit to share. One person in the village could collect quality tubers from each farming household, cut up seeds and distribute the seeds.

### **Creative, real world sales/marketing strategy to sell in Nepal**

Selling to farmers directly without the proper resources would be irresponsible and counterproductive. The best way to improve potato production in Nepal is to have an integrated system starting with seed companies who are interested in community building and building the capacity of local farmers. As mentioned, one of the challenges of potato production is disease propagation. If all farmers have is poor seed, there is no point providing them with a machine intended to increase inputs.

SAK Nepal could start with its current partner Anamolbiu to start a pilot project with a farming community and distribute/sell healthy potato seeds. At the same time, they can introduce the community to the Seed Cutter technology.

### **Canadian government grant programs to get project started**

As mentioned before, Canadian has the capacity to make a customized Manual Potato Seed Cutter. If this project inspired an entrepreneurial endeavor to design and sell a specialized Manual Potato Seed Cutter to Nepal and/or other developing countries,

there are government resources available to help with funding during the experimental phase. The Canadian Government offers a tax incentive to companies that conduct scientific research in order to create or improve a product. The program is called the Scientific Research and Experimental Design (SR&ED) Tax Incentive Program (CRA, 2015). Businesses can claim and be reimbursed a percentage of project costs such as employee wages, subcontractor fees and material expenses (CRA, 2015).

### **Regional/global competition**

To build on the previous section, there is no current competition when it comes to selling a product directly marketed as a Manual Potato Seed Cutter. There is, however, a very competitive market in terms of French Fry/Vegetable Cutters. The following list shows a snapshot of the competition. Keep in mind that the suitable blade assembly may not be available. In other words, the blades may cut potatoes into French fries only.

**Table 6:** Regional/Global Competition

<b>Location</b>	<b>Company/ Distributor</b>	<b>Product</b>	<b>Price excluding taxes and shipping</b>	<b>Reference</b>
Canada	Hendrix	Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath®	\$245.93 (10+ units)	(Hendrix, 2015)
US	Webstaurant Store	Redco® InstaCut™ 3.5 Corer, Dicer, Wedger by Vollrath®	\$242.99	(Webstaurant Store, 2015)
US	Amazon	New Star 38408 Commercial Grade French Fry Cutter, Complete Combo Sets	\$147.70 USD	(Amazon, 2015)
China	Alibaba	WPF-16 Manual French Fry Cutter	\$20-45	(Alibaba, 2015)

The prices are comparable in North America. The much lower price from China suggests that the potato cutting mechanism is available at minimal cost and is therefore scalable.

### **Future Studies**

There is still uncertainty as to whether the product will be accepted by Nepalese consumers as an addition to their traditional food production systems. There are regional differences in the way that farmers select tubers as seed (Rhoades, 1985). Therefore, it is safe to suspect that farmers may be wary of new technologies especially if they are expensive. Further studies need to be done in order to assess farmers' preferences better.

Other technical details must be accounted for such as possible trade barriers and more exact transportation logistics.

### **Conclusion**

The idea of a Manual Potato Seed Cutter makes sense but the technology is currently unavailable. The Fry Cutter only highlights that an appropriate technology is within grasp but is not appropriate for the needs of Nepal. It is too expensive and not efficient enough, even for other developing nations. In the realm of agricultural machinery intended for developing nations, it is in the best interest of potential Canadian exporters to consider smaller scale products with a lower energy input. The demand is there.

However, even if the right manual potato seed cutter becomes available to Nepal and other developing countries, the proper potato tuber must be selected for cutting. Diseased tubers have the potential to cause lots of damage. Advancing agricultural

machinery is important but if other factors are neglected and not integrated such as seed health, the entire production system is jeopardized.

**Word Count: 3689**

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