

**Canadian export to Nepal: Terad<sub>3</sub> Ag for pest control**

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## Introduction

Nepal is a country of 147 181 km<sup>2</sup>, and is located in the Himalayas between China and India (Chapagain, 2009). The population was estimated to be of 23 million people in 2009, making it the 58<sup>th</sup> most dense country in the world (UN, 2015). Because of where Nepal is located, the climate and land change drastically throughout the country

(Chapagain, 2009). Thus, the geography of the country can be divided into three regions known as the terai region, the hills region, and the mountain region (Kazama, 2011). As seen in Figure 1, the terai region is located at the south, and is the most populated due to the fact that it



**Figure 1: map of Nepalese geographical regions.**

Source: [http://assets.panda.org/img/original/ecology\\_map.jpg](http://assets.panda.org/img/original/ecology_map.jpg)

is very close to the Indian border. This region is the most temperate, and is favored for agriculture because of the relative flatness of the land and the fertile soil. Unfortunately this region is the smallest in Nepal, occupying only 23% of the total area. The hills region can be divided in the high and low hills. The low hills have partially cultivable land, but are mostly used for livestock whereas the high hills are often covered in snow. This region is very slanted, making it difficult for intensive agriculture. The mountain region is located directly in the Himalayas, and is barely populated. The mountain region occupies 35% of the total area, and is also home to the highest peak in the world, called Mount Everest.

In Nepal, agriculture is the most important source of income for many families. Unfortunately, only the terai region and part of the hills region have an acceptable

climate and fertile soil to sustain any form of agriculture (Kazama, 2011). Nepalese often practice subsistence agriculture, which means that they provide food for themselves and only sell or trade what they have in surplus to obtain income (Acharya, 2006).

Unfortunately, many farmers are unable to provide enough food for their families and need to find another source of income to buy food that is imported into the country (Acharya, 2006). Nepal's most important crop is paddy rice, with maize, millet, and wheat falling not too far behind, as seen in Table 1 (Sharma, 1999). Some crops are only suited to certain climates, and therefore need to be grown in specific regions. This would explain why rice is the most important cereal crop in the Terai region, whereas maize is the most important crop in the low/mid hills, and potato is the most important crop in the high hills (Sharma, 1999).

	<b>Crops</b>	<b>Area (ha)</b>	<b>Production (MT)</b>	<b>Yield (kg/ha)</b>
1	Paddy Rice	1 514 210	3 709 770	2450
2	Maize	802 290	1 345 910	1678
3	Millet	263 950	291 370	1104
4	Wheat	640 802	1 086 470	1695
5	Barley	31 843	31 798	999
6	Oilseed	190 429	119 731	629
7	Potato	118 043	1 091 218	9244
8	Sugar Cane	53 894	1 971 646	36 584
9	Pulses	308 008	228 840	743

**Table 1: Most popular Nepalese crops by area, yield, and production**  
 Source: Statistical Information on Nepalese Agriculture, Agriculture-Statistics Division, Nepal.

During the wheat and maize growing season, pests such as field mice often destroy a great portion of a crop if there are no other plots of the same plant growing within the area (Adhikari, 2001). Since cereal crops such as paddy rice, wheat, and maize are very important to Nepal's agricultural system, rodents can pose a large problem for farmers. Although it is most commonly thought that pests affect the crop pre-harvest, this

is not the case. Rodents are a problem not only during the growing and maturing period of cereal crops, but also post-harvest when the harvested crops go into storage (Adhikari, 2001). Nepalese often stack paddy for a few months after the crop has been harvested before threshing it, leaving full access to rodents who often depend on this to get through the season (Ganesh, 1992). Thus, rodents are responsible for a post-harvest loss of 7.3% in maize, 5.92% in wheat, and 6.22% in rice (Ganesh, 1992). This poses a great problem to Nepalese farmers, who are depending on these yields to generate an income to provide more food for their families (Kazama, 2011).

Traditional rodenticides are extremely toxic, and can cause serious secondary poisoning to other animals such as birds, cats, and dogs that may ingest the poisoned rodents (Mendenhall, 1980). Common use of anticoagulant rodenticides that prevent blood clotting have also resulted in anticoagulant resistant rats and mice, which are no longer affected by this poison (Bailey, 2000). As a solution to this problem, I have come up with a Canadian export idea that would benefit both Canada and Nepal. This would consist of sending Terad<sub>3</sub> Ag rodenticide to Nepal to help manage the rodents that are affecting crop yields. This rodenticide is not an anticoagulant, and is able to be used in organic food processing facilities (Bell Labs, 2016). This paper will analyze the export potential of Terad<sub>3</sub> Ag from Canada to Nepal, and will list how it will benefit both countries.

### **Product Description**

Terad<sub>3</sub> Ag is a rodenticide designed to control the population of rats and mice in many indoor and outdoor settings (Bell Labs, 2016). Unlike most rodenticides, Terad<sub>3</sub> Ag is EPA approved by the Environmental Protection Agency and is able to be used in

agricultural buildings and around food production areas (EPA, 2006). This rodenticide is designed for organic crop production, meets OMRI listing requirements, and has a very low risk of secondary poisoning to other animals such as birds, cats, and dogs (Bell Labs, 2016). The small blocks are moisture and mold resistant, and have a very long shelf life. This product's main active ingredient is cholecalciferol (vitamin D<sub>3</sub>), and is therefore not an anticoagulant (Bell Labs, 2016).

Anticoagulant rodenticides generally contain derivatives of indandione as their active ingredient and can often get rid of rodents within a single feeding (DeBacker, 2008). When it is absorbed through the gastrointestinal tract, the poison stops the synthesis of vitamin K<sub>1</sub> dependent clotting factors, and prevents blood clotting (DeBacker, 2008). Anticoagulants can also cause rodents to become immune to the poison, and are thus non-ideal for areas that are trying to manage a large pest problem over an extended period of time (Bailey, 2000). Instead of being an anticoagulant, Terad<sub>3</sub> Ag works by allowing vitamin D<sub>3</sub> to accumulate in the liver of the rodent and shuts down the calcium mobilization mechanism, causing blood calcium and phosphorous levels to rise until the animal dies of calcification disease (Marshall, 1984). The process of the vitamin D<sub>3</sub> as opposed to the indandione is much safer for animals that may consume the poisoned rodents, since the amount of poison consumed by a small rodent would not be able to cause enough damage to the liver of a larger animal that may be inclined to consume it (Mendenhall, 1980).

### **Where is it produced?**

A company that specializes in rodenticide called Bell Laboratories Incorporated produces Terad<sub>3</sub> Ag in Madison, Wisconsin (Bell Labs, 2016). The product does not

depend on any non-renewable sources to be made, and is mass-produced in a laboratory (Bell Labs, 2016). Although the producer refuses to sell the product to distributors that are not already on their list, a Canadian distributor named Gardex Inc. carries extremely large quantities of the product (S. Knilans, personal communication, November 28, 2016). This distributor is located in Toronto, Ontario and is willing to send products overseas (Gardex, 2015).

### **How is it used?**

Terad<sub>3</sub> Ag is used by placing the blocks in a baiting station that can be made with regular plastic pipes, as seen in Figure 2 (Bell Labs, 2016). Only 2 blocks are needed per placement, and must be present for 10 days or until there are no longer signs of mice. The baiting stations should be placed in storage facilities or around food crops, and work best if situated at 30 feet intervals surrounding the affected area. Carcass collection will be needed after the 10-day period, and all carcasses should be disposed in an area away from food handling facilities (Bell Labs, 2016).



**Figure 2: Baiting station made of pipe**

Source: <http://www.goodfruit.com/rodent-bait-station-2/>

### **Other competitive Canadian products**

Other competitive Canadian products include Resolv® soft bait made by Liphatech® (Liphatech, 2016). This type of rodenticide is more effective than regular bait blocks, and has a good aroma that seeps through the pouch to attract rodents. The product does not contain any wax, which decreases the chance of it melting while in the bait station. Resolv® is an anticoagulant, and would not be effective when dealing with anticoagulant resistant mice. Another product that is also produced by Liphatech® would

be Rozol RTU, a ready-to-use and moisture resistant grain type rodenticide. It is made with grain, and has a very long field life. Handling this product does not require the use of protective eyewear, but must be applied directly to specific animal burrows and requires more manual labor (Liphatech, 2016).

One last Canadian competitor is Syngenta Canada’s weather blox XT. The main active ingredient in this rodenticide is brodifacoum, making this product an anticoagulant (Syngenta, 2016). Although this products controls rodents in a single feeding, it contains wax and will melt at high temperatures. As seen below in Table 2, the cost of this product is quite low compared to its competitors. This product would not suit the needs for Nepal, because it is not suitable for outdoor use (Syngenta, 2016).

Product	Price per lb. (CAD)	Smallest unit size (lbs.)	Price per unit (CAD)
Syngenta weather blox XT	6.00\$	16	96.00\$
Terad <sub>3</sub> Ag	6.61\$	18	118.98\$
Rozol RTU	12.60\$	5	63.00\$
Resolv®	27.70\$	4	110.80\$

**Table 2: Price per lb. and per unit of competitive products**

Source: <http://www.domyownpestcontrol.com/>

### Health/nutritional information

Terad<sub>3</sub> Ag is a rodenticide; therefore it is toxic if ingested (Bell Labs, 2016). The product may be harmful if absorbed through the skin, and should not be present in areas that are accessible to children. The product should not be in contact with eyes, skin, or clothing as it may cause irritation. Socks, shoes, and waterproof gloves should be worn at all times while handling the product, and disposing of poisoned carcasses. Before removing the gloves, they should be washed in an area away from all food. Terad<sub>3</sub> Ag can also have a negative effect on fish, and should not be located near any natural water

sources. Preventative measures such as covering bait stations to limit precipitation access should be taken to avoid the possibility of product runoff. If the product is accidentally consumed, it is advised to contact a pest poison control center at 877-854-2494 (Bell Labs, 2016).

### **Market opportunities**

In Nepal, the potential consumers for Terad<sub>3</sub> Ag rodenticide are mostly local farmers and large food business owners who are having trouble with rodents. Therefore, this product would be satisfying the needs of a niche population. Since farmers occupy about 80% of the Nepalese population, the amount of people who are experiencing a rodent pest problem in the area is quite high (Pandey, 2008). Cereal crops such as paddy rice, wheat, maize, and millet are the most important for Nepalese farmers, and are also the most affected by rodents (Adhikari, 2001). If farmers were not losing a large portion of their yields to pests, they would have more money and food for their families (Kazama, 2011). Because of this, the farmers who could afford to buy Terad<sub>3</sub> Ag would most likely opt to buy it and use it to control the rodent population. As more farmers see how the product works to increase overall yields of cereal crops, they will consider buying the product.

To begin the marketing of Terad<sub>3</sub> Ag, I would suggest that the company targets a few wealthier Nepalese farmers that are trying to control the rodents that are destroying their crops. Once it is established that the product is working well in the area, the select farmers would be asked to communicate the success it has brought to them to other local farmers in the area. This would popularize the product, and would encourage other farmers to purchase it. Because Terad<sub>3</sub> Ag is also accepted in organic production

facilities, organic Nepalese farmers who do not want to apply pesticides to their crops can opt for this solution to conserve their organic status (Bell Labs, 2016).

### **Benefits to Canada**

Canada would benefit from the export of this product, because it would create more jobs for Canadians who work at Gardex Inc. who would have to organize the transportation of the product from Canada to Nepal. Local transport in Canada would also need to be organized, therefore there would be more jobs created for transport truck drivers who would need to bring the product from the Toronto Gardex Inc. location to Pearson International airport. This would stimulate the Canadian economy, as the country is currently in demand for blue-collar jobs (Bezdek, 2008). Another benefit that this export opportunity would bring to Canada would be that Canada would actually be exporting more of its own materials, and would have to send out more cargo planes to other countries. This would increase the country's significance in exports, and would allow Canada to gain economic growth by increasing aggregate demand, thus lowering the exchange rate (Betts, 2000).

### **Transport and Distribution**

To transport Terad<sub>3</sub> Ag from Canada to Nepal, the most efficient method would be to ship it by air. To begin, I have suggested sending 50 18 lb units of the rodenticide overseas. The product would begin at Gardex Inc., located at 7 Meridian Rd in Etobicoke, Ontario (Gardex, 2015). A transport truck or van would come and pick up the 900 lb unit, and deliver it to Toronto Pearson International Airport. A cargo plane would then ship the rodenticide to Tribhuvan International Airport in Kathmandu, Nepal (A1 Freight, 2015). The containers of Terad<sub>3</sub> Ag would then be taken by truck to Arvind Agro Centre, a

distributor and common importer located in Bara. I have chosen this distributor because it is located in the Terai region where agriculture is the most practiced, and because it is a distributor centered on agriculture (Arvind, 2015). This whole process can be viewed below in Figure 3.



**Figure 3: Flow chart demonstrating the transportation demographics of Terad<sub>3</sub> Ag from Canada to Nepal**

Once the product has arrived in Bara Nepal, farmers will be able to have access to the Terad<sub>3</sub> Ag rodenticide. The distributor will promote the new product, and may ship to local farmers when there is multiple that are requesting to receive some of their products. Individual farmers can also go to the Arvind Agro Centre in Bara to purchase the product.

### **Cost analysis**

To purchase an 18 lb. unit of Terad<sub>3</sub> Ag in Canada, the cost would be of 118.98\$. Since 1.00\$ CAD is worth approximately 81.69 Nepalese Rupees, an 18 lb. container of Terad<sub>3</sub> Ag without considering the cost of shipping would be of 9 719.48 NPR. Since the average Nepalese farmer has an average income of 16 508 NPR a year in the hills and 18 469 NPR a year in the Terai, this price would seem to be unrealistic (Kayastha, 1999). It must also be taken into consideration that about 80% of the annual income is spent on living costs, leaving the average farmer with only 3495 NPR as money to spend on tools and farming materials (Kayastha, 1999).

For the first step of the shipping process, the average cost to ship 900 lbs. of Terad<sub>3</sub> Ag from Gardex Inc. to Toronto Pearson International Airport by truck is of 1595.90\$ CAD. The cost of air shipping from Toronto to Tribhuvan International Airport in Kathmandu was quoted at 17 659\$ CAD by FedEx, and at 1 710\$ CAD by A1 freight forwarding (FedEx, 2016; A1 Freight, 2015). The cost of shipping the product from Kathmandu to Arvind Agro Centre in Bara could not be determined because quotes were not provided from the shipping company. Table 3 below compares the total cost of 50 lbs. of product if shipped by FedEx and if shipped by A1 Freight Forwarding in CAD, whereas Table 4 compares it in NPR. By looking at these tables, it is obvious that the airfreight company chosen was A1 Freight Forwarding.

<b>Company</b>	<b>Price of 18 lb Unit (CAD)</b>	<b>Price of 50 Unit (CAD)</b>	<b>Shipping From Gardex inc to Toronto (CAD)</b>	<b>Shipping from Toronto to Kathmandu (CAD)</b>	<b>Total Cost Per Unit (CAD)</b>
FedEx	118.98	5 949	1 595.90	17 659	504.08
A1 Freight Forwarding	118.98	5 949	1 595.90	1 710	185.10

**Table 3: Price to ship units with FedEx and A1 Freight Forwarding in CAD**

<b>Company</b>	<b>Price of 18 lb Unit (NPR)</b>	<b>Price of 50 Unit (NPR)</b>	<b>Shipping From Gardex inc to Toronto (NPR)</b>	<b>Shipping from Toronto to Kathmandu (NPR)</b>	<b>Total Cost per Unit (NPR)</b>
FedEx	9 719.48	485 973.81	130 369.07	1 442 563.71	41 178.14
A1 Freight Forwarding	9 719.48	485 973.81	130 369.07	139 689.90	15 120.66

**Table 4: Price to ship units with FedEx and A1 Freight Forwarding in NPR**

## **Benefits to Nepal**

For Nepal, the benefits of this product would be that there would a smaller decrease in yields for important cereal food crops across the country. Individual farmers will have more food to feed their families, and will have a better chance at producing enough to sell. This would alleviate the stress on subsistence farmers, since they would see yields for rice go up about 6.22%, maize go up 7.3%, and wheat go up 6.22% (Ganesh, 1992). Since the world population is constantly growing, it is important for Nepal to be able to produce enough food to feed their own people (Gribble, 2011). By eliminating a source of crop destruction, the country would be one step closer to this goal.

By producing enough food for the Nepalese population, the amount of starving people in the country would diminish, as the price of food would go down. This is due to the fact that the government would be importing less food products; therefore they would not need to compensate for the expensive shipping costs of the food. More people would be able to afford to feed their families, and would also be saving money on food to allow them to spend it on other important things such as tools and farming equipment.

## **Other competitive international products**

Other competitive international products include Brodifacoum TC, made in China by Fenglie Technological Development Co., Inc (Fenglie, 2016). This rodenticide is a second-generation anticoagulant that is safe to be used around humans and livestock. Because the product is located closer to its destination than the Terad<sub>3</sub> Ag, it would be a more plausible solution to the rodent problem in Nepal (Fenglie, 2016). Another competitive international product made by F. A. Richard & Co. Ltd. is Farco Rapid Kill,

a rodenticide that contains difenacoum (Farco, 2016). This rodenticide is multi-feed, and is useful when it comes to dealing with rodents who are resistant to other rodenticides such as Warfarin (Farco, 2016). These two products are a lot closer to the target destination than the Terad<sub>3</sub> Ag, and would be much cheaper for the farmers in Nepal, although they would not be very effective when dealing with anticoagulant resistant rodents.

### **Conclusion**

To Conclude, Terad<sub>3</sub> Ag is great rodenticide designed for organic production that meets OMRI listing requirements and can be used to control rodents in many indoor and outdoor settings (Bell Labs, 2016). Although the product is not made in Canada, it can be found at Gardex Inc. located at 7 Meridian Rd. Etobicoke, ON (Gardex, 2015). Compared to other Canadian products, Terad<sub>3</sub> Ag is relatively cheap, and is ideal for controlling rodents that are affecting agricultural crop yields and are present in food storage facilities (Liphatech, 2016). The product has no storage issues, since the small blocks are moisture and mold resistant (Bell Labs, 2016).

This product would be ideal for the farmers and food processing business owners in Nepal, because the country experiences rodent problems in the cereal crops that generate a majority of their food and income (Adhikari, 2001). Rodents do not only affect cereal crops such as rice, wheat, and maize before the harvest, but also after the harvesting season (Ganesh, 1992). For example, farmers often leave paddy rice out to dry for a few months before threshing it, leaving complete access to rodents who feed on it during the harsher season. This reduces yields and profit for the farmers, who often do

not have enough food to feed their family and must go find other sources of income (Ganesh, 1992).

Unfortunately, the price of this product once it is shipped to Nepal is mostly unaffordable to the average Nepalese farmer, who's annual income is of approximately 18 469 NPR (FedEx, 2016; A1 Freight, 2015). Some products available in other countries are more affordable, but are anticoagulants and are not effective in treating anticoagulant resistant mice (Fenglie, 2016). In order to make Terad<sub>3</sub> Ag a more viable option for Nepalese farmers, I would suggest that Gardex Inc. provides its own transport to Toronto Pearson International Airport. This way the cost of shipping to Nepal would diminish, and the company would benefit from selling more units to Nepal. For more information on Terad<sub>3</sub> Ag, contact Sara Knilans from Bell Laboratories Inc. at [canada002@belllabs.com](mailto:canada002@belllabs.com). Gardex Inc. can also be reached at (416) 675-1638.

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