

Export Analysis of Anthelmintic Drugs from Canada to Nepal

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Part 1: Product Information

Nepal's Sheep Issue

Nepal has a struggling economy, with a serious issue in food security (MoAD, 2016). Despite this fact, Nepal's predominant source of GDP and exports come from the agricultural industry, which in total employs approximately 70% of the population, at 38% of the GDP (MoAD, 2012). While looking further into these statistics, it should be noted that of the total revenue generated from exports, 7.4% can be attributed to hand made carpets, which generated \$78.4 in 2014 (Atlas Media, 2014). Unfortunately, a health risk within the livestock industry and specifically sheep production due to various parasites, can negatively impact the carpet making industry. As a potential solution to this issue; this paper will outline the viability of exporting anthelmintic dugs (commonly known as sheep drench) from Canada to Nepal.

Sheep Farming Logistics

Figure 2.1 Small-ruminant flock sizes in Southeast Asia (FAO 1999)

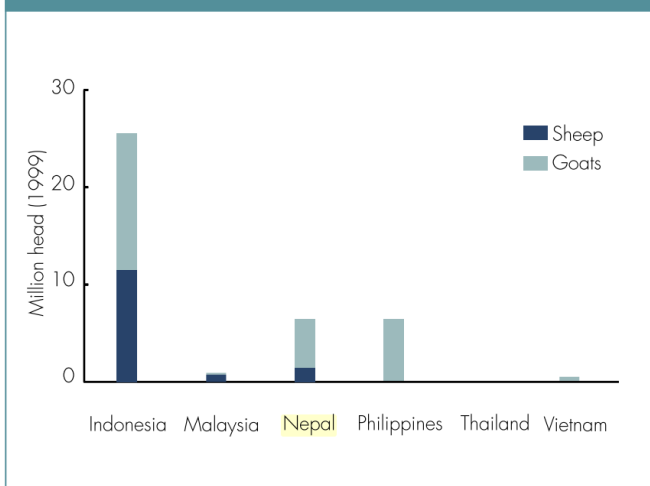


Figure 1 Nepal is the second largest producer of sheep in Southeast Asia (Sani et al., 2004).

Southeast Asia plays a major role in the world's sheep population, accounting for approximately 10% of the world's population, which is held by mostly smallholders (Sani, Gray, & Baker, 2004). In addition, sheep and goats make up 15.8% of total livestock in Nepal (FAO, 2011). This fact highlights the importance of distributing anthelmintic drugs

throughout Nepal to ensure sheep farming continues to support the economy at a farming and industrial level.

Figure 1 outlines the distribution of flock sizes throughout Southeast Asia. It should be noted that although Nepal has a relatively small flock size to Indonesia, it remains the second largest of the 6 countries. This is also important to note because of the sizeable herds in Nepal, only one region – the Mountain and Himalayas, that employ the transhumant farming system, is able to maintain such large flock sizes; whereas the rest of the country is unable to sustain this type of farming.

Sheep farming is practiced throughout Nepal, though it is most prevalent in 3 of the 4 geographic regions. The areas in which livestock farming is common are within the Northern parts of the region, referred to as the Mountain/Himalayas; the central region known as the Mid Hills; and the southern-most region as the Terai. There are also various livestock managing systems in place for these regions which include the Transhumant System; Sedentary System; and Stall-fed system, respectively (Chapagain, 2016).

Each farming system faces sets of challenges in terms of disease prevention. The Transhumant system focuses on the natural migratory patterns of sheep from lowlands to highlands, and between seasons, and consists of approximately 30% of all sheep production (Sani et al., 2004). This uncontrolled environment is subject to a higher risk of parasitic infection due to the size of the landscape that is regularly traversed, and the difficulty of administering medication to the infected ruminants. In contrast, the stall-fed or sedentary systems are easier managed since herd sizes are typically smaller, and the sheep do not have the same level of freedom as outlined in the transhumant system.

Parasite Overview

There are four genera of nematodes which are most prevalent in Asia, and these include the *Haemonchus*, *Trichostrongylus*, *Strongyloides*, and *Oesophagostomum* (Sani et al., 2004). These can be detrimental to sheep farmers and have devastating effects on herds; especially within the Transhumant farming system given most of sheep rearing is performed in the mountain/hills region. Although studies on this topic of research are scarce, it has been found that in developing nations, sheep mortality can be anywhere between 29% and 60% in perinatal sheep (Sani et al., 2004).

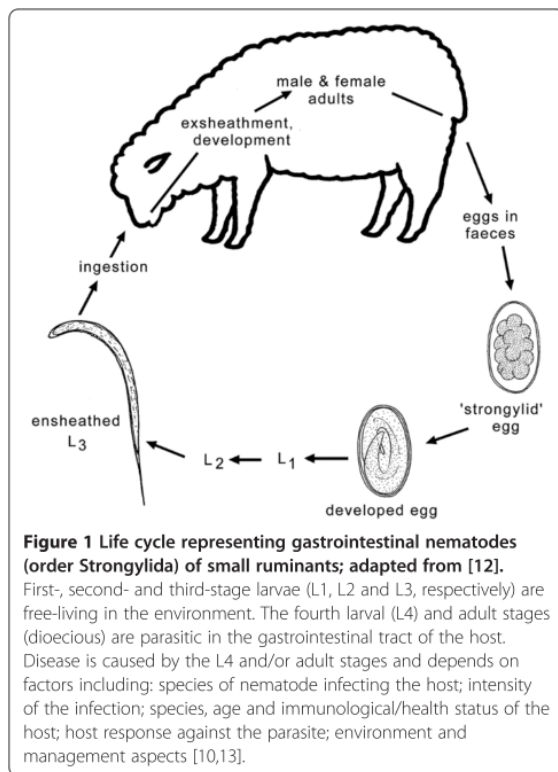


Figure 2: Life Cycle of Gastrointestinal Nematodes (Roeber et al., 2013)

Figure 2 outlines the common life cycle of Nematode (Strongylida) parasites in small ruminants. Infection rates and vulnerability can vary between species of nematode, and species of the host; as well as other factors including host's age, immuno-compromisation, and exposure to ensheathed (free-living) environmental parasites (Roeber, Jex, & Gasser, 2013).

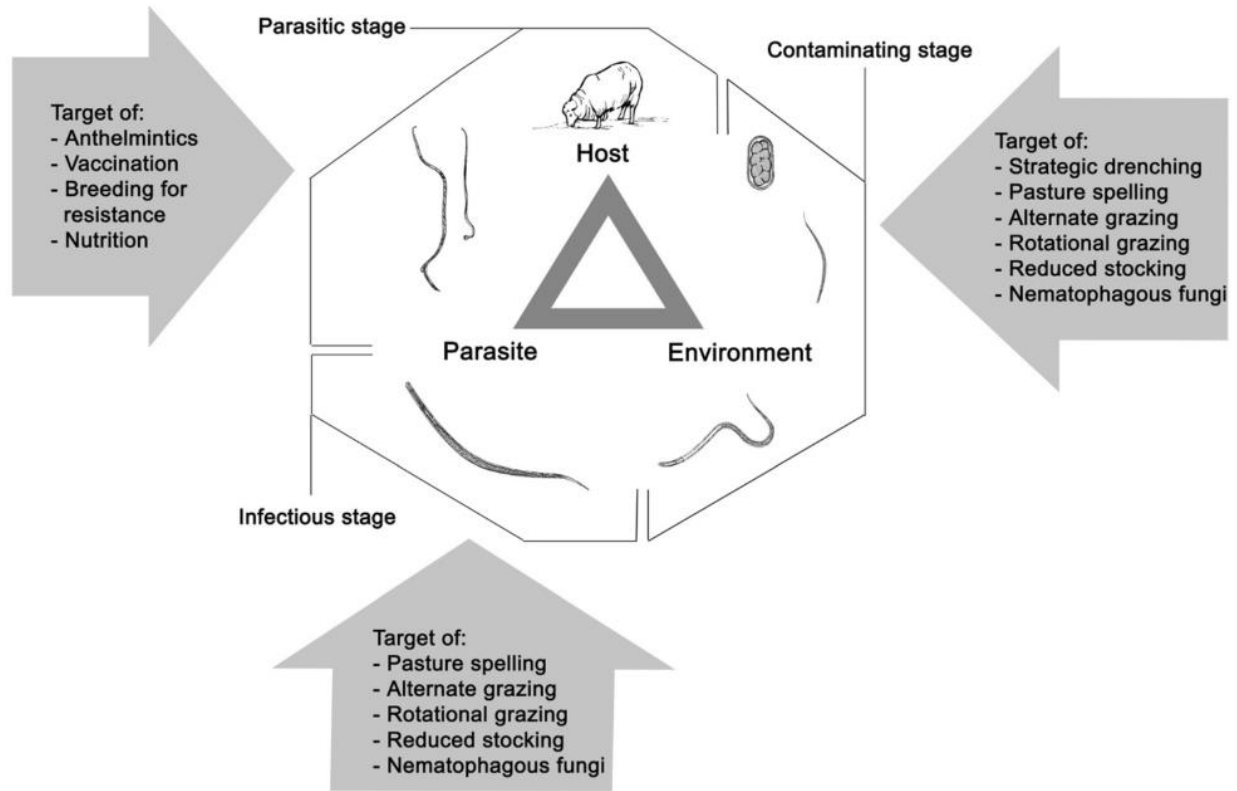


Figure 3: Relationship between the Parasite, Host, and Environment. (Roeber et al., 2013)

Figure 3 outlines the interaction between the parasite with the host and the environment. Three stages are present in this diagram, which are the parasitic stage, contaminating stage, and infectious stage. The key information to be derived from the figure above is the stages in which strategic drenching, rotational grazing, and anthelmintics are of most importance. In relation to anthelmintic treatment and environmental factors, the contamination stage should focus on a strategic use of drenching and rotational grazing; the infectious stage should focus on rotational grazing, and the parasitic stage should focus on anthelmintic use.

Strategic use of drenching, rotational grazing (which is already employed in the most prominent form of sheep farming – the transhumant system), and proper anthelmintic use should reduce the prevalence of parasites in hosts. Exercising these techniques could positively impact the Nepalese economy, given that regions in Southeast Asia have an endemic case of nematodes in small ruminants (Roeber et al., 2013).

| Worm | Sedentary | Migratory |
|--------------------------------------|-----------|-----------|
| <i>Haemonchus contortus</i> | * | * |
| <i>Trichostrongylus axei</i> | * | * |
| <i>T. colubriformis</i> | * | * |
| <i>T. vitrinus</i> | * | * |
| <i>T. orientalis</i> | * | * |
| <i>Bunostomum trigonocephalum</i> | * | * |
| <i>Cooperia curteici</i> | * | * |
| <i>C. punctata</i> | * | * |
| <i>Oesophagostomum asperum</i> | * | * |
| <i>O. venulosum</i> | * | * |
| <i>Trichuris ovis</i> | * | * |
| <i>Strongyloides papillosus</i> | * | * |
| <i>Teladorsagia circumcincta</i> | * | * |
| <i>T. daviani</i> | | * |
| <i>T. trifurcata</i> | | * |
| <i>Ostertagia leptospicularis</i> | | * |
| <i>O. nianquingtanggulaensis</i> | | * |
| <i>Grossospiculagia occidentalis</i> | | * |
| <i>Chabertia ovina</i> | | * |
| <i>Skrjabinema ovis</i> | | * |

Figure 4 illustrates the various parasite species that affect small ruminants in Nepal, under two different farming systems. The migratory farming system would fall under the Transhumant system, which is also the most prominent way of raising sheep in Nepal. From this chart, it should be noted that the range of parasites that can infect the host is increased with the migratory system, and therefore places a larger burden on farmers to maintain proper drenching or rotational grazing practices.

Figure 4: Gastrointestinal parasite species of small ruminants reared under sedentary and migratory management systems in Nepal (Sani et al., 2004).

Ivomec® Sheep Drench

Product

Ivomec® Drench for Sheep is an anthelmintic produced in Quebec, Canada, by Merial. This product covers a wide array of parasites such as gastrointestinal nematodes, lungworm, and nasal bot. The gastrointestinal nematodes that are included under this umbrella are the same ones

which are most commonly affecting the Nepalese sheep population – the nematode strongylida.

The product should be administered in a single dose, orally, at 2.5ml per 10kg of body weight.

The treatment should be repeated any time a parasitic infection occurs (Merial, 2016).

Environmentally, the product is safe to use and farmers should not have any concerns regarding residuals or possible spillage, as when the ivermectin comes in contact with soil, it slowly becomes inactive. An added benefit is the storage temperature for ivermectin, at 30 degrees Celsius, which falls under the average temperature for Nepal of 23 degrees Celsius (Merial, 2016).

IVOMEC® DRENCH FOR SHEEP
Merial
(ivermectin)
DIN 00622125
VETERINARY USE ONLY
Active Ingredient: Each mL contains 0.8 mg of ivermectin.

WARNING
Treated animals must not be slaughtered for use in food for at least 14 days after the latest treatment with this drug.
Keep out of reach of children.

INDICATIONS
IVOMEC® is indicated for the treatment of parasitic infestation due to:
GASTROINTESTINAL NEMATODES
Adult and immature forms of *Haemonchus contortus*(1), *Ostertagia circumcincta*(1), *Trichostrongylus axei*, *T. colubriformis*(1), *Oesophagostomum columbianum* and *Cooperia curticei*.
Adult forms of *Nematodirus battus*, *Oesophagostomum venulosum*, *Chabertia ovina*, *Trichuris ovis* and *Strongyloides papillosus*.
Immature forms of *Nematodirus spathiger*.

LUNGWORM
Adult and Immature forms of *Dictyocaulus filaria*.

NASAL BOT
All larval stages of *Oestrus ovis*.

(1) Includes known benzimidazole-resistant strains.

DOSAGE AND ADMINISTRATION
IVOMEC should be given as a single dose treatment. Administer orally at a dose of 2.5 mL of IVOMEC per 10 kg of body weight, with any standard drenching equipment which provides a consistent dose volume. Repeat treatment may be necessary when reexposure to parasite infection occurs.

ENVIRONMENTAL SAFETY
Studies indicate that when ivermectin comes in contact with the soil, it readily and tightly binds to the soil and becomes inactive over time. Drug containers and any residual contents should be disposed of safely (eg. by burying or incinerating) as free ivermectin may adversely affect fish or certain water-borne organisms.

CAUTION
Coughing, which usually lasts for only a few minutes, may occur in a small percentage of sheep immediately after treatment; this passing response is of no consequence.

STORAGE
Do not store this product at a temperature exceeding 30°C.
Merial Canada, Inc., 20000 Clark Graham, Baie d'Urfé, Québec H9X 4B6
®Registered trademark of Merial.

| | |
|---------------|------------------------------|
| Net contents: | |
| 1 L | |
| 2.5 L | 2022-2957-00 2022-2958-00 |

CPN: 1182036.2

Figure 5: Ivermectin Sheep Drench Product Label. Source: <https://merialce.naccvp.com/product/view/1182036>

Ivomec Sheep Drench is packaged in either a 1 L or 2.5 L jug, which contains 1000 mL of drug or 2500 mL respectively. With a standard dosage of 2.5 mL per 10kg of body weight, this equates to 11.25 mL needed to treat a ruminant with an average weight of 100lbs. Under these assumptions, a 2.5 litre jug of Icomec® can treat approximately 222 sheep.

Potential Product Ineffectiveness

According to research conducted by the Australian Government through the Australian Centre for International Agricultural Research, ivermectin resistances could be present within sheep populations in Southeast Asia. It was observed that farmers who are relatively wealthy within Southeast Asia, that the common use of ivermectin created some inherent resistance (Sani et al., 2004). However, the lower economic status of Nepalese farmers, it can be concluded that ivermectin based products such as Ivomec® will not have any issues in treating parasitic infection, since farmers likely do not have abundant access to the drug.

Company Overview

Merial is headquartered in Lyon, France, with offices all over the world. However, offices were established in Montreal, Quebec, and have been operating in Canada for over 30 years. Merial Canada conducts outreach programs to developing nations, with the focus of ensuring food security and conducting epidemiological research. Not only does Merial have the means to provide anthelmintic products to sheep herders, but they also possess the intellectual capacity to aid Nepalese farmers in maintaining a healthy livestock herd. In addition to the intellectual capacity, Merial is also partnered with world government agencies such as the World Organisation for Animal Health (OIE), and the UN's Food and Agriculture Organization (FAO). (Merial, 2016)

An added benefit to a multinational company, are the offices and support that are located on a global scale. Merial also has offices in Mumbai, India, which could be utilized by the Nepalese if specific needs were to arise.

Benefits

Canadian Benefits

Canada and namely Canadian producers of Ivermectin and Icomec® sheep drench would benefit from trade with Nepal, in a few ways. First, Canadian producers of ivermectin such as the Alberta Veterinary Institute, or Merial Canada, would have increased revenues due to the ability to sell to a larger consumer base. This increased revenue however, would be unsubstantial as the Nepalese farmers do not have the same level of financial security as North American farmers.

The benefit to Canadian industry would rather be in an intangible asset such as “goodwill”. Merial has proven that outreach programs and investing in developing nation’s agricultural infrastructure is valuable, through the already pre-existing research and development projects taking place.

Other local producers of ivermectin would be able to take advantage of the “goodwill bandwagon” and increase their intangible assets. The positive perception of the company derived from their involvement within developing nations would reflect positively, and give domestic consumers an extra incentive to purchase their product.

With Canada in the forefront as the lead producer of anthelmintics for Nepal; other branches of Merial could benefit as well. Merial offices in India would have the opportunity to

produce the drug, and utilise connections with Nepal to turn profit, while maintaining the favourable reputation in Canada which would act as free marketing.

Nepalese Benefits

Investment into livestock agriculture, namely sheep herding, by Merial Canada would benefit Nepalese farmers and communities greatly. Among the symptoms from nematodic infection, reduced production of wool and muscle mass, also sudden death is commonly associated (Roeber et al., 2013).

| Animals | Total number of faecal samples examined | Intestinal parasites | | | Total number of blood smears examined | Blood parasites | | |
|---------|---|----------------------|------------|----------------|---------------------------------------|--------------------|------------|----------------|
| | | Number of positive | Percentage | χ^2 value | | Number of positive | Percentage | χ^2 value |
| Sheep | 251 | 169 | 67 | 65.0** | 242 | 27 | 11 | 15.4** |
| Goats | 379 | 131 | 35 | | 312 | 9 | 3 | |

**Value with similar superscript in a column is highly significant ($p > 0.01$)

Figure 6: Prevalence of Internal Parasites in Tamil Nadu (Velusamy, Rani, Ponnudurai, & Anbarasi, 2015).

Figure 5 displays the severity of intestinal parasites in sheep and goats for Western Tamil Nadu. In this report, the assumption will be that Nepalese sheep have a similar exposure and infection rate as the Indian region of Tamil Nadu. This assumption will be justified by comparing the similarity in climate and economic status of the two regions.

A faecal sample size of 251, 169 were found to be contaminated with intestinal parasites. This leaves the sheep population open to exposure and the often fatal symptoms to follow. However, with the introduction of Ivomec®, sheep mortality should be greatly reduced. Around the world, the sheep industry relies heavily on the proper administration of anthelmintics to reduce infection from parasites; therefore Nepal should have access to this same level of treatment (Sutherland, Shaw, & Shaw, 2010).

According to a study conducted by the School of Environmental and Rural Science through the University Of New England, Australia; the wool production of sheep while uninfected by parasites is 2.3g/d higher than infected sheep (Kelly, Walkden-Brown, & Kahn, 2012). This loss in wool production is detrimental to Nepal's export potential of hand-woven carpets, and in turn reduces the standard of living for families.

The impact of Nepal's wool industry on their export potential is significant because, in 2014, Nepalese carpets consisted of 7.4% of Nepal's total exports, which totalled \$78.4 million dollars (Atlas Media, 2014). This continues to be Nepal's #1 export, and if the industry wanes, the national GDP would fall, and families would be in a worse economic state.

Not only would Nepal benefit from the product itself, but with Merial's involvement and reputation as an innovator, Nepal could potentially benefit from increased relations with Canada, and epidemiological research. Currently, there are few studies pertaining to sheep production in the hilly regions of Nepal, with the only ones present being very dated. With farmers having the necessary tools to be educated in regards to parasite prevention, this will only further increase wool yields through informed use of the sheep drench.

PART 2: Export Potential to Nepal

Cost Analysis

Product Costs

Ivomec® Drench for Sheep, through a third party retailer, comes up to \$103.40 CAD for a 1 Litre jug (Jefferspet, 2016). Assuming the product has a mark-up of approximately 20% in order for the retailer to gain profit, we will conclude that the product coming directly from Merial, due to a partnership with farmers in Nepal, will cost \$80 CAD.

Transportation Costs

DHL is a freight company that ships to worldwide locations. Under their specifications, Nepal is categorized under the South Asian destination prices, which costs \$54.86 CAD for 1kg, or 1 Litre of product (Lan, L., 2013). In addition to this, remoteness fee may apply if the location is in a hard-to-reach area. The remoteness fee costs \$37.55 CAD (Lan, L., 2013).

Farmer's Costs

One jug of Ivomec® sheep drench, with shipping and remoteness fee included, is approximately \$172.41 CAD. This translates in to 14145.22 Nepalese Rupees at current 2016 exchange rates (Google Finance, 2016). Adding on to these assumptions; if the average sheep herd size for a farmer within the transhumant system is 30, then this means one 1 Litre jug would be able to service 2.96 herds. This information was derived from the amount of Ivomec® drug that is needed to cure one sheep. If the drug is divided up between farmers; that would mean

each farmer would be able to service almost the entirety of their sheep herd, for \$57.47 CAD or 4,715.07 NRP.

Export Potential

Poverty

There are many barriers that may block potential trade with Nepal, especially in terms of the country's poverty and geographic location. The Gross National Income in 2014 for Nepal was \$730.00 USD, which may be inflated due to domestic government workers or Nepalese citizens who are working overseas (Rural Poverty, 2014). Taking this in to account when considering export potential of a product that would cost an individual ~\$172.41 CAD, greatly reduces it's potential to become a household product. If this price is broken up between three farmers, and communities have the ability to come together and share in the cost of this product, the individual cost would go down to \$57.47.

Geography

Geographically, Nepal is a landlocked country with improved access to imports from neighbouring countries such as India or China. Importing products from Canada will be expensive and inefficient unless both countries can find benefit from the trade. In order for Canada to ship a product from Nepal, the cost of the product is almost doubled from \$103.40 CAD to \$172.41 CAD. If the product were to be shipped from a closer location, or produced within Nepal, these costs would be greatly reduced.

Transportation Logistics

Distribution of the product once it reaches Nepal would be a challenge in itself. According to the WorldBank, a lack of accessibility from economic centres to more rural parts of the country is one of the root causes of conflict and instability (WorldBank, 2013). This obstacle

would make it difficult for the product to reach farmers in Northern Nepal, as the destination is within the mountainous Himalayas for sheep herders. Since DHL would have to ship to the closest mainland to Nepal, being India – Merial India could have the potential to help transport the product north to Nepal.

Competitive Products

Ivomec® Sheep Drench contains the active ingredient of 0.8mg of ivermectin per mL of drench (merialce, 2016). Ivermectin is a common drug used to treat gastrointestinal nematodes in sheep; therefore a product such as Ivomec® is not necessarily needed when the pure drug is already accessible (cswri, 2016). Competitive products in the market would be any drug that is readily available for use, at a cheaper cost, that may be produced locally. The incentive to buy Ivomec® specifically would be for the added benefit of potential outreach and research initiatives conducted by the parent company Merial.

Recommendations

The ability for farmers to buy Ivomec® Sheep Drench will be entirely up to the individual's income. Unless government intervention and subsidies can offset some of the costs – farmers may not find value in the product. However, if the product proves to be useful in that increased revenues from treated sheep, in the form of increased wool and meat production, can offset these costs; then it is possible that the farmers would have an incentive to buy the drug from Canadian producers.

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