Traditional Nepalese Fruit Leathers

Traditional Nepalese fruit leathers, known locally as *Mada*, are snacks that can be made from a variety of fruits (Poudel, 2003). This paper will investigate the socio-economic and environmental sustainability of preparing *Mada* from Nepalese Hog Plum (*Choerospondias axillaris*), referred to as Lapsi in Nepali (Poudel, 2003).

Production

C. Axillaris is an indigenous deciduous fruit tree grown in the mid- and high mountain regions of Nepal (Poudel, 2003). Lapsi fruits resemble white-fleshed plums with yellow-green skin; when eaten raw, the fruit can be very sour (Labh, Shakya & Kayasta, 2015). Because of this, Lapsi fruit is often made into pickled sauces, candy and dried into leathers (Poudel, 2003). Although Lapsi is used medicinally in Vietnam, only the Nepalese consume the fruit for its flavour and nutritional benefits (Poudel, 2003). Lapsi contains several essential amino acids, including arginine (106mg/100g), glutamic acid (36mg/100g), and glutamine (32mg/100g) (Poudel, 2003). It is also rich in vitamins and minerals such as Vitamin C, potassium (355mg/100g), magnesium (34mg/100g) and calcium (57mg/100g) (Poudel, 2003). Lapsi fruit is also shown to be an excellent source of antioxidants (Labh et al.). According to the Government of Nepal, 7387.68 metric tons of Lapsi were produced in Nepal between 2012 and 2013 (2013). Processing Lapsi into fruit leathers has significant potential for generating income for hillside farmers through agroforestry.

Production Constraints

A notable issue in fruit cultivation in mountainous regions of Nepal is the lack of soil fertility (Devkota, 1999). Due to economic constraints, commercial fertilizer is

widely unattainable, which forces farmers to rely on farmyard manure and compost (Devkota, 1999). Possible interventions for this issue include intercropping fruit trees with nitrogen-fixing legumes, as well as mulching (Atreyaa, Sharmab, Bajracharyab, & Rajbhandari, 2008). Another constraint is the lack of horticultural training available to farmers and entrepreneurs (Devkota, 1999). Training focusing on breeding, such as the selection of superior germplasm is needed (Poudel, 2003). Training centering on proper pruning and tree maintenance in order to improve yields and fruit quality in the long term is also necessary (Devkota, 1999).

Sustainability Factors

Environmental Sustainability

Intensification of agricultural practices, although necessary to prevent food insecurity in rural areas, poses an environmental threat to mountainous regions in Nepal (Schwab, Schickhoff & Fischer, 2015). Mountainous regions are naturally prone to soil erosion and nutrient leaching, which when combined with agricultural intensification has major implications for soil fertility (Schwab et al.). Increasing the prevalence of agroforestry (defined as combining the production of crops, trees and shrubs on agricultural land) will enhance and protect future soil fertility in the middle and high mountain regions of Nepal (Schwab et al.). For example, Lapsi could potentially be cultivated in combination with nitrogen fixing legumes and other cash crops, such melons, berries or kiwifruit, which would provide ground cover and reduce soil erosion. Where possible, integrating livestock production into the system (known as silvo-pastoralism) is beneficial, as it provides manure for fertilizer, and *C. Axillaris* leaves can be used as fodder (Schwab et al.). Ensuring continued soil sustainability and productivity

through agroforestry will allow farmers to produce larger yields of higher quality crops, which will provide households with a more secure income source (Scwab et al.).

Agricultural intensification can also lead to reduced levels of biodiversity, as mono-cropping is adopted as the conventional system (Schwab et al.). Agroforestry – especially that which includes indigenous species such as *C. Axillaris* – can help to preserve biodiversity in threatened areas (Schwab et al.).

Economic Sustainability

The initial investment in *C. Axillaris* trees may pose an issue for many Nepalese farmers. Furthermore, it is important to note that only female trees produce fruit (Poudel, 2003). Due to a lack of horticultural training, especially regarding early sex determination of seedlings, many farmers are reluctant to invest in the trees due to the risk of non-bearingness (Poudel, 2003). Furthermore, *C. Axillaris* trees can take seven to ten years to bear fruit, which can deter rural farmers who need more immediate returns on their investments (Poudel, 2003).

Lapsi tree leaves can be used as livestock fodder, which is an important economic benefit for farmers who own livestock (Schwab et al, 2015). Further research conducted on the possibility of selling *C. Axillaris* leaves as fodder would be beneficial.

Because the regions where Lapsi is grown are mountainous and remote, farmers face unreliable road access and transportation issues that limit market access (Devkota, 1999). Due to the prevalence of improper storage conditions and precarious transportation methods, there is little market for highly perishable fruits, such as peaches and plums locally, which forces farmers to sell them for very low prices (Devkota, 1999).

Processing fruit into leathers, which are far less perishable and likely to be damaged during transportation is an ideal intervention to counteract these issues.

Cultural Sustainability

Agriculture is the largest economic sector in Nepal – employing approximately 75% of the labour force – and is therefore critical to national employment and poverty reduction (Schwab et al., 2015). Currently, Nepal is undergoing a period of agricultural feminization, as there is a growing trend towards men seeking non-agricultural employment in urban centres (Allendorf, 2007). In 2001, more than 90% of female workers in Nepal worked in the agricultural sector (Allendorf, 2007). Increasing the incomes of rural female farmers through the sale of value added products such as *Mada* will result in significant positive implications for rural communities. This is due to the fact that increasing women's incomes is shown to have a direct impact on the health and nutrition of their children (Allendorf, 2007).

Export Potential

In 2012 Canada imported 4,269,012 dollars (CAD) worth of fresh, frozen and dried fruit (Chowdhury, 2013). Globally, Canada is the 7th largest global importer of fresh and processed fruits (Chowdhury, 2013). Canadian consumers are highly interested in healthier food options, which is leading to increasing demand for fresh and processed fruits (Government of Canada, 2015). For example, per capita consumption of dried fruit products in Canada increased by 8% between 2000 and 2010 (Government of Canada, 2015). Lapsi is rich in antioxidants, vitamins, minerals and amino acids making it an ideal product for health conscious consumers (Labh et al., 2015; Poudel, 2003).

Furthermore, Canada's population is becoming increasingly ethnically diverse (Government of Canada, 2015). Combined with an increasingly globalized society, this is creating a strong demand for food products that appeal to ethnically diverse consumer palettes (Government of Canada, 2015). This trend towards ethnic based foods and food product diversity is expected to continue to grow (Government of Canada, 2015). Partly as a result of this growing trend, the majority of Canadian processed fruit and vegetable imports are products that are not grown in Canada, such as Lapsi (Government of Canada, 2015). In addition, Canadian consumers show strong preferences for food that are convenient, for example, those that are portable, and available in snack-sized packaging (Government of Canada, 2015). All of the above preferences of Canadian consumers indicate that *Mada* is an ideal export product for Canada.

Canadian Regulation

Nepalese fruit leathers imported to Canada would have to meet a variety of regulatory standards. This includes the Canadian Agricultural Products Act, the Food and Drugs Act, and the Pest Control Products Act (Government of Canada, 2015). The fruit leathers would also have to be packaged and labeled in accordance with the Consumer Packaging and Labelling Act (Government of Canada, 2015). In order to meet this requirement, further research is required in order to ascertain the product's exact nutritional information. Ensuring that products meet these standards may pose a challenge for rural farmers who face issues with lack of access to information and language barriers.

Potential Importers

1. Ambrosia Natural Foods – Two locations in Ontario

- Thornhill, Ontario Location
  Phone: (+1) 905-881-7811 Email: thornhill@ambrosia.ca
- Vaughan, Ontario Location
  Phone: (+1) 905-264-2510 Email: Vaughan@ambrosia.ca

2. Goodness Me – Locations across Ontario

- Phone: (+1) 844-255-0842 Email: info@goodnessme.ca

3. The Big Carrot Natural Food Market – Toronto, Ontario

- Phone: (+1) 416-466-2129 Email: james@thebigcarrot.ca (store manager)

Conclusion

Although there are several constraints which may impact farmer's decisions to invest in *C. Axillaris* trees for Lapsi production for *Mada,* in the long term it is an excellent investment. Drying high value fruit into leathers prevents waste during storage and transportation, which helps improve and secure incomes for hillside farmers in Nepal. Furthermore, adoption of agroforestry practices helps prevent environmental degradation as a result of agricultural intensification, and ensure sustainable long-term land use, which in turn has positive economic implications. In terms of the Canadian market, there is a definite demand for healthy, convenient and diverse food products such as traditional fruit leathers. However, meeting international standards and regulations may provide a challenge for rural farmers.

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