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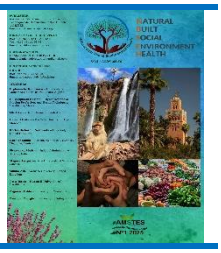

LETTER TO THE EDITOR

Himalayan Freshwater: A Huge Potential to Nepal's Economy

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Sir,

Nepal, nestled in the Himalayas, is endowed with pristine glacial water and natural springs. Of the total water in the world, only 2.6% water is freshwater, and most of this water is located in the Himalayan region, in an untouched state, making it suitable for drinking [1]. Often considered as the "Water Tower of Asia", the Hindu Kush Himalaya (HKH) region is a great source of freshwater, with Nepal having 210 cubic kilometres of renewable water resources, being ranked 43rd globally [2]. Nepal's Himalayas spans 800 km in the central range, including 2,323 glacial lakes with a coverage of 75 km^2 [3]. These bodies of glacial water and natural springs are naturally pure and free from pollutants. The mineral contents like Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), etc., essential for human health, are readily available in these sources [1]. Despite such huge potential, this water is not being used for consumption.

Because many consumers have health concerns, the global demand for naturally nutrient-rich drinking water is very high. The regions with scarce drinkable water, such as the Middle East, and other arid regions across Asia and Africa, are compelled to rely mainly on imported or commercially bottled water rather than mineral-rich water. In 2024, the Middle East imported US$251 million worth of bottled water; the Gulf Cooperation Council (GCC) nations accounted for nearly US$225 million [4]. In the current scenario, France, producing Evian bottled water, has been listed as the top exporter of naturally nutrient-rich drinking bottled water, with an export value of about US$1.15 billion [5]. The global demand for this water is growing and Nepal holds great potential to enter this market. Unfortunately, Nepal has not been able to meet both the national and international demand to date.

Only three companies, namely Himalayas on Top, Rasuwa Water, and Api Spring, are currently operational, but the production is far below their capacity, focusing only on natural spring water and

neglecting the glacial sources. Although the production capacity of these companies is about 4000-4800 litres of bottles per hour, only 2% of this capacity is being used for bottling in the present day as a result of technological constraints. Table 1 compares the mineral composition of the commercialized bottled water of France and Nepal.

Table 1. Comparison of Mineral Content (mg/L) in Bottled Water from France [6] and Nepalese Brands

Mineral (mg/L)	Evian (France)	Himalayas on Top (Nepal)	Api Spring (Nepal)	Rasuwa Water (Nepal)
Calcium (Ca^{2+})	80	1.2	2.5	2.5
Magnesium (Mg^{2+})	26	0.48	0.5	0.5
Sodium (Na^{+})	6.5	1	1.74	1.6
Potassium (K^{+})	1	0.7	1.36	1.3
Chloride (Cl^{-})	10	0	2.8	2.8
Total Dissolved Solids (TDS)	345(180 °C)	16	75	10
pH	7.20	6.68	6.5-7.0	6.5-7.0

Without any chemical treatments, additives, disinfectants, or preservatives, French bottled water Evian is high in minerals like TDS, Calcium, and Bicarbonate because it is sourced from the French Alps, which have dominant limestone and dolomite rocks, where the water is slowly filtered through prolonged contact with soluble rocks and water [6].

In contrast, Nepali Himalayan water has low mineral content because it runs off quickly through hard rocks such as granite and schist; as a result, the interaction of water with mineral-rich rocks is limited. Calcium and Magnesium content present in water define its hardness. Hardness ranges from soft (below 17 mg/L) to very hard (greater than 180 mg/L) [7]. According to WHO, the pH range between 6.5 to 8.5 is the recommended limit for drinking water, as pH may affect the corrosiveness, and Total Dissolved Solids (TDS) below 300 mg/L is considered excellent, and above

1200 mg/L is unacceptable because of unappealing taste and health concerns [8]. The calcium supports bone strength, magnesium aids heart functionality, and potassium imparts blood pressure

regulation. Besides, these elements provide water with a naturally smooth and appealing taste, different from purified alternatives. Hollow membrane filtration, a purifying technique often used by Himalayan water bottlers, removes all the bacteria without excluding essential minerals. The membrane filtration process, whether microfiltration, ultrafiltration, or nanofiltration, uses hollow membranes depending on their pore size.

The normal Himalayan water production cost, exclusive of all the indirect costs, is 20-30 NPR per litre, with the market price ranging from 100 NPR domestically (about US$ 0.75) to 0.9 to 1 US$ internationally. Currently, with three operational plants, each having a capacity to produce about 4800 bottles per hour over 8 hours a day for almost 300 days a year, 34.56 million litres of water are annually produced. Assuming 70% export and 30% sold domestically, the total annual revenue generated would become approximately US$31.97 million. Adding 5 more plants over the next five years would increase the annual revenue to US$85.25 million, considering the same export-domestic ratio.

With the growth of this industry, the direct and indirect sectors required are bottling and packaging, transportation, logistics, export and trade, sales, marketing, and brand development. Given Nepal's unemployment rate of approximately 4.4%, the creation of such jobs could assist the rural, high-altitude communities by reducing poverty and fostering local development [9]. Furthermore the adequate investments in infrastructure like roads, manufacturing facilities, and logistics can be beneficial to the overall development of the Himalayan water industry, along with improvement in regional connectivity. The proposed scenario also benefits the key factors, tourism and agriculture, by contributing approximately 24% and 27% to Nepal's GDP. [10] Considering Nepal's rugged terrain, the transportation of Himalayan water from remote sources to the bottling plant and export hubs is a serious challenge. A local helicopter service, Altitude Air charges NPR 340 per kg (with a limit of 500 kg in one flight) or US$2,200 per hour.

In contrast, land transport via trucks is cost-effective, but poor road conditions may increase delays and expenses. With the growing impacts of climate change, floods and prolonged droughts have become extensive and serious issues, reducing the availability of clean and reliable sources of water. [11]. Further, the escalated glacier melting caused by climate change increases the risk of Glacier Lake Outburst floods (GLOFs). Yet controlled extraction from the glacial lakes prone to outburst can be done in order to reduce lake volumes, alleviate natural dam pressure, obtain nutrient-rich water, and contribute to economic growth by reducing the risk of disasters to the downstream communities. The 1985 Dig Tsho GLOF resulted in the loss of US$1.5 million, and the 2016 Langmale GLOF resulted in over US$5 million losses [12]. So by integrating the water extraction from glacial lakes,

GLOF can be mitigated to some extent, along with the conversion of the potential liability into an asset.

The commercialization of Himalayan water from Nepal could help to meet the global demand for mineral water of high quality and it would bring economic development to Nepal in line with the Sustainable Development Goals [13]. This water is naturally filtered, composed of favourable minerals, and free from external pollutants, which is all attractive to the growing health-conscious market. With the advances in technologies, better transport infrastructures, startup initiatives, and supportive governmental plans and policies in glacial water extraction, Nepal can represent itself remarkably in the demanding world market, turning the pure mountain water into liquid gold.

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Yours sincerely,

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