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EXECUTIVE SUMMARY

Women in mountainous areas play vital roles as farm workers, income producers, and custodians of traditional knowledge, despite facing economic barriers. Promoting gender equality through nature-based enterprises can drive sustainable development and improve food security. Challenges such as insufficient funding and limited rural access hinder the progress of women's empowerment in India. The Biological Diversity (Amendment) Act, 2023 emphasizes sustainable use and equitable benefit-sharing from biological resources, offering opportunities for women's empowerment in mountain regions. Himachal Pradesh's *Rosa moschata,* once considered a weed, is now recognized for its economic value in personal care and medicinal products. Research from Kullu Valley shows how it can empower rural women economically while conserving biodiversity. Government policies like the Biological Diversity (Amendment) Act, 2023 and Himachal Pradesh Herbal Policy (2006) support biodiversity conservation and community livelihoods. Technological advancements improve product quality and reduce labor in women-led businesses. Key recommendations include decentralized procurement, product diversification, support for labor-saving technologies, and fostering research collaborations. Community engagement is essential for achieving long-term conservation and economic resilience.

BACKGROUND

In rural areas, women contribute significantly as wage earners, farmers, and entrepreneurs, in addition to their household duties. This situation extends to mountain ecosystems, where women bear multiple responsibilities in both domestic and agricultural spheres. Indigenous women often serve as guardians of traditional knowledge, which is fundamental to their unique way of life, resilience, and cultural identity. However, barriers exist to involving rural women in economic activities. Promoting gender equality and empowering women through rural job creation using local natural resources could foster sustainable economic growth, helping to alleviate poverty and enhance food security. The United Nations (UN), Government of India (GoI), and International Labour Organisation (ILO) are dedicated to advancing gender equality and women's economic empowerment in rural regions. While numerous national policies address women's economic empowerment, implementation gaps persist due to inadequate funding and resources, limited rural accessibility, underrepresentation of women in decision-making, lack of awareness, and insufficient gender-sensitive approaches. The Indian government's Biological Diversity (Amendment) Act, 2023 promotes the sustainable utilization of biological resources and traditional knowledge, recognizing the importance of local and indigenous communities in preserving biodiversity. This legislation offers a chance to boost women's empowerment in mountainous ecosystems through the use of biological resources for economic activities, ensuring equitable benefit-sharing, and safeguarding traditional knowledge. In mountain areas where women are responsible for household and farming duties, programs aligned with this Act can foster their involvement in sustainable ventures. The Sustainable Development Goals (SDGs) play a crucial role in this context, particularly SDG 5, which strives for gender equality and women's empowerment, and SDG 15, which aims to protect ecosystems, manage forests sustainably, combat desertification, and halt biodiversity loss.

The *Rosa* genus, comprising over 140 species, is used worldwide for its varied therapeutic, aromatic, and medicinal qualities (Cairns, 2003). Of these, 25 species are found in India, with 5 species occurring in Himachal Pradesh (Wissemann and Ritz, 2005; Sharma et al., 2012). *Rosa moschata,* also known as *R. brunonii,* thrives in degraded areas, near water sources, forests, and riverside habitats in and around villages in the Kullu Valley, Himachal Pradesh (Shashni and Sharma, 2022). Its flowers, roots, and fruit-bearing seeds are used to create personal care products. These items possess therapeutic properties and are effective as antimicrobial, diuretic, and antispasmodic agents, as well as for treating skin conditions, healing scars, and reducing photo-aging, among other benefits (Demir and Ozcan, 2001). Although widely distributed, the local population has traditionally viewed *Rosa moschata* as a weed with no economic value. However, recent studies on rosehip have revealed its potential for small-scale business development (Singh et al., 2021; Shashni and Sharma, 2022). The Biological Diversity (Amendment) Act, 2023 provides a structure for incorporating the sustainable use of such native species into community-driven economic activities while ensuring biodiversity conservation. This policy brief is based on the work conducted in the Gadsa Valley of Kullu district, Himachal Pradesh, focusing on the use of *Rosa moschata* plant parts to develop various products, with the main goal of economically empowering rural women in the area. It demonstrates how utilizing prevalent and endemic plant biodiversity can economically benefit indigenous people while promoting biodiversity conservation.

PROBLEM STATEMENT

Rosehip is distributed throughout the Kullu district in forest areas, barren lands, and near agricultural bunds. The species commences flowering from April to June, with seeds maturing in late October and becoming ready for harvest thereafter. The study area is characterized by dispersed settlements at various altitudes. Due to deeply entrenched social norms, certain communities often reside in the periphery of villages, where the land is typically less fertile and limited in size. Engaging rural women in the sustainable utilization of *Rosa moschata* can support and contribute to their economic empowerment. This approach will also address gender disparities among rural populations by harnessing the potential of rural women, thereby promoting sustainable development and achieving broader objectives such as gender equality, technological interventions, poverty reduction, and environmental conservation.

Figure 1. Map of the Gadsa valley in district Kullu, Himachal Pradesh

OBJECTIVES AND GOALS

To enhance the socio-economic status of rural mountain communities, particularly women, by promoting the sustainable use of bioresources.

RESEARCH OVERVIEW

STUDY AREA

Five panchayats of the Gadsa Valley, namely Garsa, Manjhali, Bhalan, Jeshta, and Parli (Fig. 1), encompassing 64 villages and 2111 households with 48.35% women members.

DESIRED OUTCOME

Economic empowerment of women through increased income and livelihood opportunities, skill development, conservation of *Rosa moschata* through propagation and sustainable utilization, improved social status due to financial independence, development of strong community networks, high-value rosehip product development, and strengthening of the value chain through a sustainable business model.

BENEFICIARIES

Total 24 women's saving and credit groups (WSCGs), comprising 203 females engaged in rosehip harvesting and processing, were established. At the unit level, 4 women adopted product development, while 1 member employed in marketing activities. Additionally, capacity of 700 women was built in sustainable harvesting techniques and post-harvest handling of the species.

ROSEHIP HARVESTING AND POST-HARVEST PROCESSING

Mature, healthy, and bright red pods of rosehip were sustainably harvested from wild populations growing in Gadsa valley. Women were the primary collectors of rosehip pods, dedicating 2-3 hours per day to collection activities. Rosehip collection sites were selected based on species availability and were verified to be free from contamination. Post-harvest, the seeds were sorted, cleaned, and sun-dried on clean sheets to prevent ground contact, particularly on the first day of harvest. Seeds were evenly distributed and periodically agitated to ensure consistent drying. Subsequently, final drying occurred in shade, with seeds considered fully dried (10-15% moisture content) when easily breakable under light pressure. The dried seeds were then stored in airtight drums or clean bags prior to product development and further processing to prevent contamination.

MODIFICATION OF POST-HARVEST PROCESSING TECHNIQUE

In the initial phase of the project, processing of rosehip seeds was conducted manually using a conventional pestle and mortar. This traditional method yielded a processing capacity of only 3.5 kg of seeds per person per day (8 hours). The process was not only time-intensive but also physically demanding. To address these limitations and reduce labour intensity, a seed shredder cum separator machine was developed and implemented. This machine has a deshelling capacity of 200 kg of rosehip seeds per day (Plate 1), representing a significant improvement over the manual method. The machine was designed with food safety considerations, incorporating components such as the roller and sieving platform made of food-grade stainless steel. This design ensures that the seeds remain free from contamination throughout the processing stages. The seed shredder has substantially improved processing efficiency and reduced the physical strain involved, rendering the work more manageable and sustainable for the women participants.

Plate 1. Rosehip Seed Shredder machine

ROSEHIP PRODUCT DEVELOPMENT

ROSEHIP TEA

The two types of tea i.e. plain rosehip tea and an amalgamation of rosehip and mint were developed under the brand name 'Mountain Bounties'. The tea product is packed in biodegradable, unbleached and non-carcinogenic tea bags and loose form was packed in containers or packets. (Plate 2 a-b).

Plate 2. a) Rosehip mint tea packed in container; b) Rosehip tea packed in tea bags; c) Rosehip seed oil packed in amber bottle

ROSEHIP SEED OIL

Rosehip seeds were processed through supercritical extraction method to obtain the rosehip seed oil. (Plate 2 c). The tea and oil exhibit significant antioxidant activity (Shashni and Sharma, 2022), and the oil possesses a favorable fatty acid composition, which is advantageous for the development of various oil-based skin care products. FSSAI certification of the products was also obtained.

Plate 3. Rosehips, rosehip seeds and tea

PRODUCT OUTPUTS

Over the three-year duration of the project, a total of 7.4 tons of rosehip seeds were procured from WSCGs. The project commenced with an initial capital allocation of Rs. 1.25 lakh for seed procurement and an additional Rs. 1 lakh for oil extraction. Upon project completion (May 2019), the rosehip-based enterprise had generated revenue of approximately Rs. 7.78 lakh from rosehip tea production and Rs. 9.46 lakh from rosehip seed oil production (Table 1). The revenue continued to increase, reaching Rs. 25 lakhs by March 2023 after accounting for all processing costs, including wages, GST, retail margin, packaging and labeling, oil extraction, and marketing. During the project, two products were developed: rosehip tea and rosehip seed oil (Plate 2). Cost kinetics in terms of monetary inputs and outputs are presented in Table 1. The project activity has not only provided a sustainable income source for the women but also established a foundation for continued growth in the enterprise.

Table 1. Detailed Analysis of Rosehip Seed Oil and Comparative Evaluation of Quality Parameters of Rosehip Oil from Various Enterprises and Companies

	Specification Range	**Rosehip *(Rosa moschata)* Kullu**	**Rosehip oil Commercial brand 1 *(Rosa canina)***	**Rosehip oil Commercial brand 2 *(Rosa canina)***	**Rosehip oil Commercial brand 3 *(Rosa canina)***	**Rosehip oil Commercial brand 4 *(Rosa rubiginosa)***	**Rosehip oil Commercial brand 5 *(Rosa rubiginosa)***
Appearance	Clear orange liquid	Liquid, Clear Pale orange	Clear liquid orange	Liquid Golden-Orange	Pale yellow	Pale yellow to yellow clear oily liquid	-
Odour	Characteristic	Pungent	Characteristic	Fatty bland odor, slightly tart	-	Faint oily smell	-
Specific gravity	1.470-1.482	0.9317		0.9262	-	0.921	-
Refractive index@ 20°C	1.470-1.482	1.4726@ 40°C	1.478	1.482	1.48	1.4802	
Iodine Value	150 – 194	154	161	-	177	177	172
Unsapnifiable Value	-	1.67	-	1.5	0.6	-	1
Saponification value	185 – 209	176	N/D	-	184	196	186
Free fatty acid value	≤ 0.5	5.41	0.07	-	-	0.06	0.06
Ester Value	-	165.18	-	-	-	-	-

Glycerol content	-	9.05	-	-	-	-	-
Peroxide value	≤ 10.0	Absent	0.86	-	2.3	0.9	1.6
Palmitic acid	2.0 – 10.0	6.6	4.03	3.7	3.6	3.7	
Stearic acid	1.0 – 7.0	3.69	2.86	1.7	2.7	2.2	2.2
Oleic acid	10.0 – 20.0	13.39	19.04	14.3	15.1	13.9	14.3
Linoleic acid	35.0 – 60.0	51.88	49.12	44.5	44.9	45.9	45.4
Alpha linolenic acid	20.0 – 50.0	19.44	23.26	34.9	32.5	32.7	31.2
Arachidic acid	< 2.0	5.94	0.62	0.36	0.6	0.4	0.3

Table 2. Cost kinetics for development of Rosehip products.

Description	2016-17	2017-18	2018-19	Total
Total Rosehip Procured (kg)	2272.00	2382.00	2791.00	7445.00
Total Cost of Rosehip Procured (Rs.)	125000.00	131000.00	152191.00	408197.00
Total rosehip tea production	908.80	952.80	1116.40	2978.00
Total revenue from Rosehip Tea (Rs.)	130000.00	349763.00	298503.00	778226.00
Cost involved in rosehip seed oil production	204480.00	214380.00	251190.00	670050.00
Total rosehip seed oil production	37.04	38.84	45.51	121.39
Total revenue from Rosehip Seed Oil (Rs.)	-	388442.00	557101.00	945543.00

WOMEN EMPOWERMENT (PRE AND POST PROJECT IMPACT ASSESSMENT)

A series of training programs were conducted in various villages for Women's Saving and Credit Groups (WSCGs) to enhance awareness regarding rosehip, its sustainable harvesting, and post-harvest processing practices. Awareness was disseminated among the women through posters and presentations related to harvesting and post-harvest processing protocols. They were also informed about the species' regeneration practices. Previously, due to a lack of knowledge, local inhabitants cut the bushes. The women were encouraged to cultivate the species along their agricultural bunds as fencing, which would protect their crops from wild animals while also facilitating harvesting to promote economic upliftment. Through project activities, each woman earned up to Rs. 30,000/- from the collection and sale of rosehip seeds. Women are gaining economic benefits during product development and sales, which contributes to the sustainability of the enterprise. Approximately 58 women members were approached for pre- and post-project feedback regarding social, technical, economic, and environmental indicators (see Figure 2). A detailed empowerment study is available on the Department of Science and Technology, Government of India website (https://dst.gov.in/success-stories-dst).

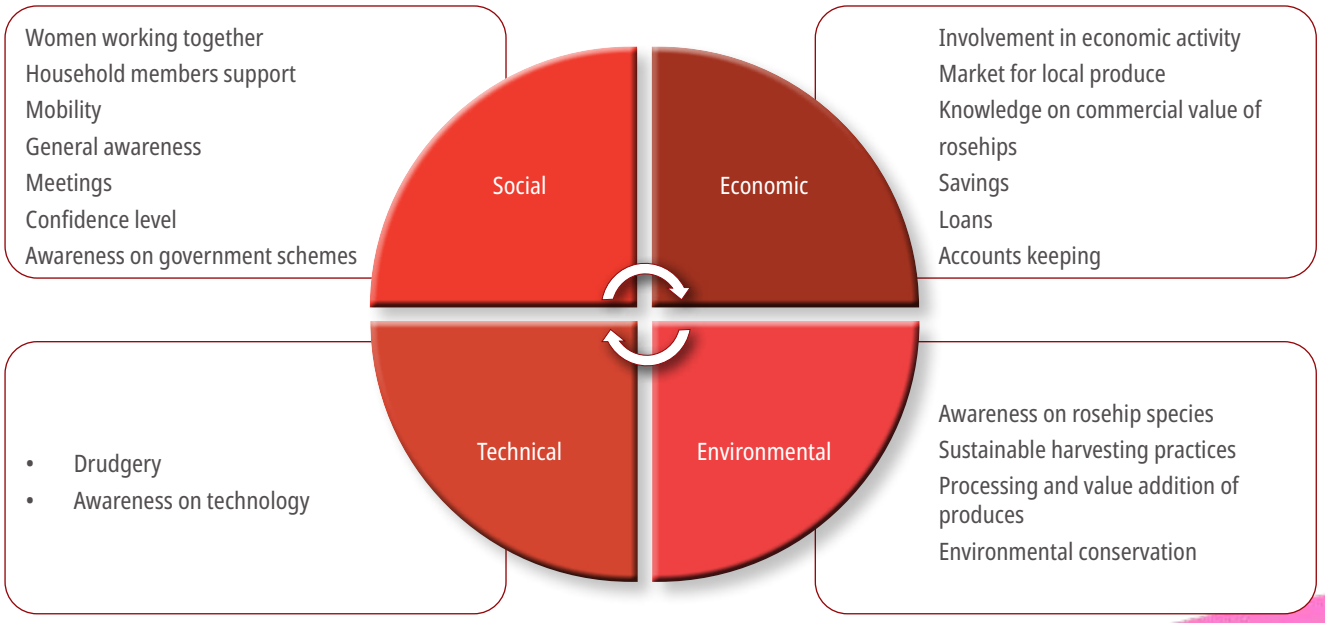

Figure 2. Indicators used for pre and post project impact assessment

POLICY RECOMMENDATIONS

Various governmental initiatives and policies are being enacted to promote the sustainable use of biodiversity, conserve biological resources, and enhance the socio-economic status of communities. These include the Biological Diversity (Amendment) Act 2023, the Himachal Pradesh Herbal Policy of 2006, as well as programs like Biodiversity-Based Livelihood Initiatives and the National Rural Livelihood Mission (NRLM). These measures aim to balance the preservation of biological resources with their utilization for community development.

This project aligns with governmental initiatives that have successfully generated economic prospects for women and expanded them through policies promoting sustainable growth. Recognizing the economic worth of wild forest products such as rosehip and embracing sustainable methods can enhance livelihoods while conserving biodiversity. Technological advancements reduce workload and enhance product quality, boosting the economic viability and competitiveness of female-led businesses. Utilizing rosehip bushes as natural barriers supports both conservation efforts and local economies. Linking sustainable resource utilization to community livelihoods ensures long-term conservation objectives and bolsters local economies. Achieving widespread community engagement is crucial for the success of any sustainability-focused initiative, and increasing awareness about the advantages of such efforts can boost overall support. The project findings suggest the following recommendations:

- Establish and support decentralized procurement and marketing systems for rural women, guaranteeing markets for bioresource-derived products.

- Offer incentives for product diversification to minimize reliance on a single product and strengthen economic resilience.

- Implement policies like the Biological Diversity (Amendment) Act 2023, which promotes sustainable collection and use of natural resources, particularly lesser known bioresources such as rosehip, along with capacity building in sustainable harvesting techniques.

- Provide financial and technical assistance for introducing labour-saving technologies in rural enterprises, especially for women-led initiatives. Collaborations with research institutions would be beneficial in driving innovations in product processing and quality enhancement.

- Encourage the planting of bioresources that serve dual purposes, such as natural fencing and income generation.

- Create microfinance schemes and low-interest loan programs tailored for rural women engaged in bioresource-based enterprises. Financial literacy training and support mechanisms will aid in ensuring efficient fund utilization.

- Promote community-based conservation initiatives aligned with livelihood projects. These projects could be connected to national and international conservation funding through Access and benefit-sharing (ABS).

- Foster gender-inclusive awareness programs focused on the importance of sustainable resource management and bioresource utilization, ensuring community-wide participation and support.

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About the Institute:

G.B. Pant National Institute of Himalayan Environment (NIHE) was established in 1988, during the birth centenary year of Bharat Ratna Pt. Govind Ballabh Pant, as an autonomous Institute of the Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India. The institute has been identified as a focal agency to advance scientific knowledge, to evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and to ensure environmentally sound development in the entire Indian Himalayan Region (IHR).

The Institute follows a multidisciplinary and holistic approach in all its Research and Development programmes with emphasis on interlinking natural and social sciences and particular attention is given to the conservation of fragile mountain ecosystems, indigenous knowledge systems and sustainable use of natural resources. Training, environmental education and awareness to different stakeholders are essential components of all the R&D programmes of the Institute.

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