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Triple Problems of Nepalese Hills: Low Income, Migration and, Land Use Changes – One Possible Solution: Specialty Rice

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The hills of Nepal face a complex triad of interrelated challenges: low income, outmigration, and land abandonment leading to aquifer desiccation, with low income serving as the precursor of this vicious cycle. The Nepalese hills harbor two significant yet underutilized potentials. First, the picturesque terraces, a legacy of preceding generations, are unfortunately abandoned and neglected. Second, these hills harbor diverse landrace varieties of rice, each with unique traits, though only a limited number among them have received the deserved recognition and fair market prices. This study seeks to identify and analyze these rice varieties, investigate their value chain, and conduct a comparative cost-benefit analysis against other rice varieties across Nepal to evaluate their economic feasibility. This study, conducted across 12 districts in Eastern Nepal, involved 12 focused group discussions with rice farmers, 200 individual interviews with rice farmers, as well as 10 individual interviews each with rice millers, agro vets, and rice traders. The research employed cost-benefit analysis as a tool to assess economic feasibility. The findings

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indicated that some of these rice varieties demonstrate a benefit-to-cost ratio ranging from two to four times higher than conventional rice varieties. The economic viability of most other varieties remains unknown as they have not yet been tested in the market. These findings present crucial insights for researchers, policymakers, development practitioners, and the private sector to further explore, act upon, facilitate, and invest in the untapped potential, aiming to break the vicious cycle and ensure increased income, reduced migration, and conservation of ecological and environmental resources.

Keywords: Vicious cycle; landrace rice; terraces; value chain; cost-benefit analysis; economic viability.

1. INTRODUCTION

1.1 The Triple-Fold Problem

Currently, the hills of Nepal face a trio of interconnected issues, namely low income, outmigration, and changes in land use leading to the drying of aquifers. The phenomenon of outmigration is influenced by a plethora of push factors. In the case of the Nepalese hills, the impetus for migration predominantly resides in factors associated with diminished economic opportunities [1].

A series of scholarly investigations reveals a discernible trend over the past three decades, wherein a growing proportion of agricultural land in the mid-hill regions of the country has undergone a state of either underutilization or abandonment [2, 3]. Similar studies have delineated a spectrum of pivotal 'drivers' contributing to the phenomenon of land underutilization. These include, but are not limited to, outmigration [4, 3, 5, 6], urbanization [7], an increase in remittances and pensions [8], as well as the diversification of household income and livelihood strategies [9,10]. This compendium of identified drivers coherently converges towards a singular paramount motif: the pursuit of enhanced livelihood opportunities, with income serving as a pivotal facet thereof.

Empirical evidence suggests that escalating water insecurity has served as a catalyst, prompting individuals to allow land to remain underutilized [11]. Respondents attributed this phenomenon to the perceived progressive desiccation of spring water sources, positing it as a vital factor contributing to water insecurity. Terrace-based rice farming stands as a predominant feature in hilly regions, where terraces serve as pivotal components for water retention and the recharge of aquifers. It is observed that water sources and springs downstream of terrace rice farming areas remain active, resulting in a diminished occurrence of drought. Conversely, in regions where terraces have deteriorated and rice farming is abandoned, downstream water sources experience a reduction or complete desiccation. A discernible positive feedback loop has been established, demonstrating the interconnection between terrace abandonment and the subsequent decline in water resources. A study has distinctly indicated that the act of terrace abandonment has resulted in a substantial reduction, i.e., approximately 30%, in the aggregate groundwater recharge [12]. This underscores the efficacy of terrace-based rice farming as a mechanism for rainwater harvesting and aquifer recharge. Hence, the prevalence of low income has given rise to outmigration, subsequently triggering the abandonment of land and the desiccation of aquifers, thereby perpetuating a vicious cycle.

On a positive note, there have been instances where a cash crop boom, such as in the case of quinoa in Bolivia, can also trigger migrants to return [13]. Similar occurrences have been documented in Nepal, wherein the rise in the price of cardamom has induced individuals to migrate back to hilly regions, reinitiating cardamom cultivation as a viable economic pursuit.

1.2 Rice as a potential Solution

Rice holds a preeminent status as Nepal's primary staple crop, with maize and wheat trailing behind in order of agricultural significance. Its pivotal role in the realm of food and nutrition security is underscored by substantive statistics, constituting 23% of protein intake and a significant 67% of total cereal consumption, as delineated by the Ministry of Agriculture and Livestock Development [14]. The economic contribution of rice is equally noteworthy, contributing 7% to the overall Gross Domestic Product (GDP) and a substantial 20%

to the agricultural GDP, as elucidated by the Central Bureau of Statistics [15].

Within the cultural fabric of Nepal, rice assumes a profound and intricate role entwined with religious, cultural, and traditional values, permeating the entire spectrum of life from birth to funeral ceremonies. Rice's pivotal role in safeguarding food security is reaffirmed by its provision of over 30 percent of the caloric requirement and exceeding 50 percent of the grain demand, according to the Ministry of Agriculture and Development [16]. The per capita consumption of milled rice is estimated at 174 kilograms annually in Nepal, as reported by the Central Bureau of Statistics [17]. An additional dimension is revealed through the elasticity of demand functions, indicating a pronounced affinity for rice; a 0.9 percent escalation in income corresponds to a commensurate increase in demand for fine rice, while income growth correlates inversely with the demand for maize [18].

1.2.1 Production

In the fiscal year 2021, the estimated paddy production in Nepal reached 5,621,710 metric tons, cultivated across an expanse of 1,473,474 hectares. Over six decades, commencing in 1961, the aggregate paddy output has demonstrated a remarkable increase of 166%, juxtaposed with a more modest expansion of approximately 35% in the cultivated land area for paddy. The average yield has witnessed a twofold increase during this period, rising from 1.9 tons per hectare (t/ha) to 3.8 t/ha. While this trajectory represents a positive trend in absolute terms, its relative significance is tempered by the almost 190% surge in population during the same temporal domain. The productivity of Nepal's rice subsector, gauged at 3.8 t/ha, lags behind neighboring countries such as Bangladesh (4.8 t/ha) and China (7.1 t/ha), although it remains comparable to India (4.2 t/ha) and Pakistan (3.9 t/ha). Analyzing the annual growth rates between 1961 and 2017, Nepal's rice output expanded at a rate of 1.14 percent, a figure notably lower than its regional counterparts, India (2.5 percent), Bangladesh (3 percent), and China (4.2 percent), as well as the global average (4.5 percent) [19].

1.2.2 Consumption and import

As of 2017, the projected annual demand for milled rice in Nepal amounted to 4.08 million tons (equivalent to 6.56 million tons of paddy), as compared to a total production of 3.25 million tons of milled rice (equivalent to 5.2 million tons of paddy). In 2019, the country resorted to importing 0.75 million tons of milled rice, as reported by the Trade and Export Promotion Center [20] It is found that both the quantity and value of rice imports are increasing at rates of 24.48% and 38.11% per annum, respectively, while the growth in domestic production lags at less than 2% per year [21]. Consequently, the Nepalese government has strategically prioritized the increase of domestic rice production as a measure aimed at mitigating the country's annual import costs, which currently stand at $300 million. This strategic initiative aligns with the imperative of enhancing national food security and minimizing reliance on external sources for this vital staple crop.

The trajectory of rice imports into Nepal has witnessed a substantial escalation over the preceding decade. In 2010, the nation imported an estimated 144 thousand metric tons (MT) of rice, and by 2021, this figure soared to over 1.3 million metric tons (MT), marking a tenfold surge. Correspondingly, the financial magnitude of this import activity exhibited a dramatic rise, escalating from approximately $44 million in 2010 to an estimated $450 million in 2021, reflecting an increase of more than tenfold. Noteworthy is the fact that a staggering 99 percent of the total rice imports are sourced exclusively from India, underscoring the paramount role of this neighboring nation in catering to Nepal's burgeoning rice import requirements. This substantial surge in rice imports signals a nuanced dynamic within Nepal's agricultural landscape, prompting a closer examination of the implications for domestic rice production, trade dependencies, and overall economic resilience.

1.3 Landrace Rice Varieties of Nepal

Nepal is endowed with a rich diversity of rice germplasm, comprising numerous distinct rice landraces, each manifesting an idiosyncratic characteristic. The discovery of rice grains dating back five centuries in Simraungardh, Bara illustrates Nepal's prominence as a pivotal center of global rice diversity [22]. Currently, 8389 rice accessions are curated across domestic and international gene banks within Nepal. While 2500 accessions have been systematically cataloged by the NAGRC/NARC, a significant portion of the germplasm remains uncharacterized [23].

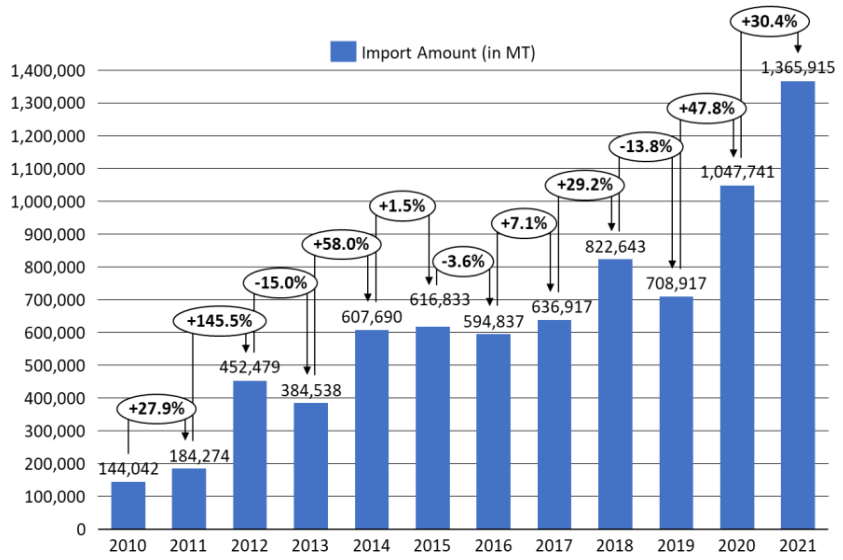

Fig. 1. Quantity of Imported Rice in Metric Tons (Source: Trade and Export Promotion Center)

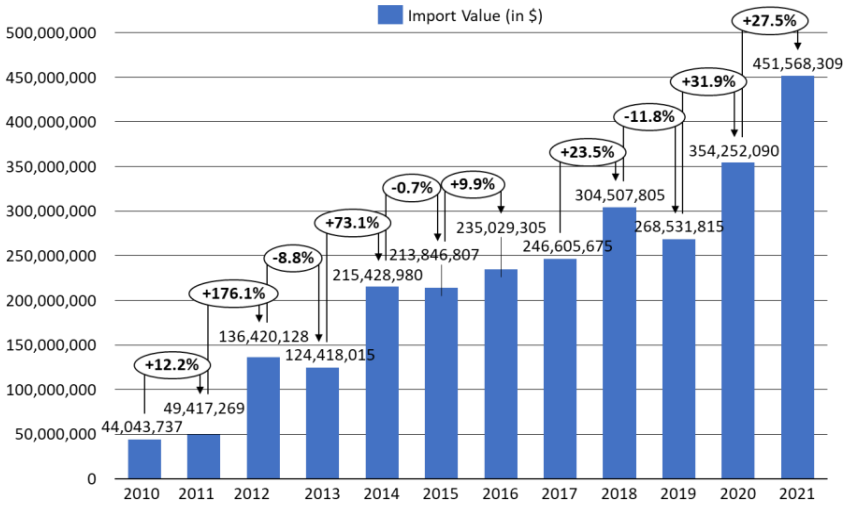

Fig. 2. Dollar Value of Imported Rice in Nepal (Source: Trade and Export Promotion Center)

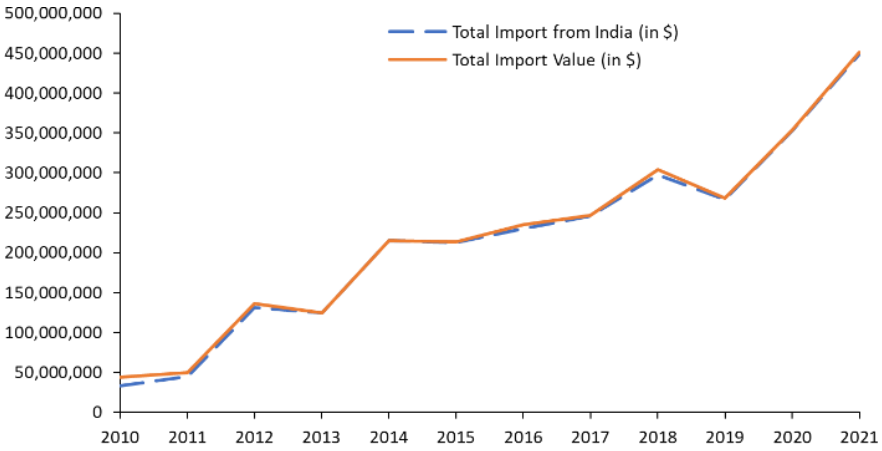

Fig. 3. Comparison of Value of Rice Imported from India vs. Total Import Value (Source: FAOSTAT)

The average area share of landraces is slightly over 10% in Nepal. By season, this accounts for 10.3% during the Barkhe (rainy) and 8.8% during the Chaite (dry) seasons [24]. The popular varieties grown are *Belguthi*, *Atte*, *Dudhe Marshi*, *Mansara*, *Sepilo*, and *Halkuda* in the eastern mountains, and *Belguthi*, *Atte,* and *Chirakhe* in the eastern hills. On the other hand, *Basmati*, *Chanamchur*, *Sathiya*, *Chirakhe*, *Kariyakamod*, *Jaswa*, *Belguthi,* and *Kalo Nuniya* are the landraces cultivated in the eastern Terai. The top five varieties in terms of area coverage are *Pokhreli Masino, Anadi, Marshi, Anpjhutte,* and *Ghiya* in the central mountains. *Pokhreli Masino, Basmati, Manbhog, Mansara*, and *Bhotagi* are the dominant landraces in the central hills, while *Basmati, Kariyakamod,* and *Kalanamak* are cultivated in the central Terai. In the case of the western hills, the landrace diversity is quite high (in terms of numbers). The landraces cultivated are *Jethobudho, Jarneli, Jhinuwa, Ekle, Gudura, Panhlele Dhan, Anadi, Gauriya, Gurdi, Anpjhutte,* and *Mansara,* while *Kalanamak, Makarkaddu, Latera, Pidani*, and *Saratha* are cultivated in the western Terai. The varieties popular in the mid-western mountains are: *Palte dhan, Bhattalo, Basmati, Jumli Marshi/Kali Marshi, Junge, Chinamari,* and *Ghaiya*. The landraces cultivated in the mid-western hills are: *Jugari, Dada Mansuli, Basmati, Marshi, Jodan (Kalo/ Seto/Pahelo), Pokhreli Masino, ParanPyuli, and Pyuthani Seto,* while *Shyamjira, Gauriya, Sindur, Anadi, Kalanamak, Kanakjira, Tilki, Makarkaddu,* and *Sugabodh* are popular in the mid-western Terai. In terms of landrace diversity, it is quite high in the far-western hills as well. The popular cultivated landraces in the far-western hills are: *Thapachini, Jorayal Basmati Shyamjira, Marshi, Jaulo, Ratodhan,* and *Dudhe*. On the other hand, *Anjana, Tilki, Jhinwa, Anadi,* and *Raimanuwa* are the major landraces cultivated in the far-western Terai. However, several other landraces are being grown by farmers in remote areas and small portions of land are not covered by this study.

The exclusive adoption of semi-dwarf alien advanced and uniform rice varieties has led to the slow and steady extinction of indigenous rice landraces [25]. Farmers ceased maintaining their indigenous seed stocks while simultaneously purchasing rice seeds from the market that had good and uniform yields and were responsive to inputs. Nepal started to lose tens of thousands of landraces over the years, which was a significant part of its culinary and agricultural history [26].

However, the most important challenge exists within the value chain of these varieties. Except for a few, such as Pokhreli, Jumli Marsi, Jetho Budo, Anadi, and Taichin, which have garnered favorable market prices nationally and occasionally internationally, the majority of other varieties have remained unnoticed. This can be attributed to the limited and localized nature of their value chain, often extending only from the farmers' fields to their homes for personal consumption, or at most, reaching the local market.

2. MATERIALS AND METHODS

The primary aim of this study is to scrutinize the value chain of specialty rice in the eastern region of Nepal. The specific objectives delineated are as follows:

1. To identify the indigenous rice varieties grown in the Eastern hills of Nepal.
2. To study the various stakeholders and business enablers engaged in the rice value chain within the Eastern region.
3. To conduct a comparative analysis, contrasting the profitability of the identified specialty rice varieties with that of other conventional rice varieties.

In pursuit of the study's objectives, a holistic research approach was adopted, employing both qualitative and quantitative methodologies. Both secondary and primary sources of data are used. Secondary sources, such as government reports, articles, and existing publications, were consulted to establish a foundational understanding. The primary data collection was executed through focused group interviews, individual questionnaires, and direct observations, ensuring a multifaceted data-gathering process. This hybrid approach facilitated a thorough exploration and analysis of the subject matter.

A focused group discussion approach was employed for the interview process, involving a total of 12 groups. The participants were organized into groups, with each group comprising 10 farmers. The interviews were conducted across various districts, namely Morang, Sunsari, Jhapa, Dhankuta, Bhojpur, Panchthar, Taplejung, Terathum, Sankhuwasabha, Okhaldhunga, Khotang, and Solukhumbu, thereby providing a geographically diverse and representative sample for the study. An additional 200 individual interviews were

undertaken, employing a stratified sampling method based on rice variety. This approach ensured a representative and systematic selection of samples aligned with the diversity of rice varieties under consideration, thereby enhancing the comprehensiveness of the study. Moreover, an additional set of interviews were conducted with 10 individual millers, 10 agrovets, and 10 traders. The interviews were structured in an open-ended questionnaire format, allowing for an in-depth exploration of perspectives and insights from these key stakeholders in the rice value chain. This targeted approach aimed to capture nuanced information and diverse viewpoints from individuals directly involved in the various facets of the rice industry. A conclusion has been drawn through data analysis and the perception of the researcher what he has perceived at the time of the field visit.

A detailed cost-benefit analysis was conducted after the computation of total variable costs and gross returns derived from paddy cultivation. The cost of production was ascertained by aggregating all variable cost items associated with the cultivation process. The gross return was determined by accounting for the income generated from the sale of the agricultural product. The benefit-cost analysis was subsequently executed using the formula:

$$\text{B/C Ratio} = \frac{Gross\ Return}{Total\ Variable\ Cost}$$

where,

Gross return (NPR) = (Total quantity of paddy sales in kilograms * Price per kilogram of paddy) + (Revenue from sales of the by-product).

Total variable cost = Cost of production i.e. land preparation, transplanting, nutrient management, weeding, harvesting, transportation and storage.

3. RESULTS AND DISCUSSION

3.1 Cost of Production Analysis

A breakdown of the average costs involved in the production of rice across 42 districts in Nepal suggests that human labor accounts for almost two-thirds of the entire cost. The usage of tractors accounts for the next considerable portion (5.6 percent), followed by labor performed by bullocks (5.1 percent), and then interest payments (4.3 percent). The cost of production showed variation in the use of human labour and mechanical devices when compared between hills and terai districts.

3.2 Profit Analysis

Among rice varieties in 42 districts, the *Khumal 11* variety from Bhaktapur has the highest yield, while the *Ekle jaat* variety from Kaski has the lowest yield. A Pearson correlation coefficient of -0.36 indicates that the negative link between premium varieties and low yield is not as significant as is widely believed.

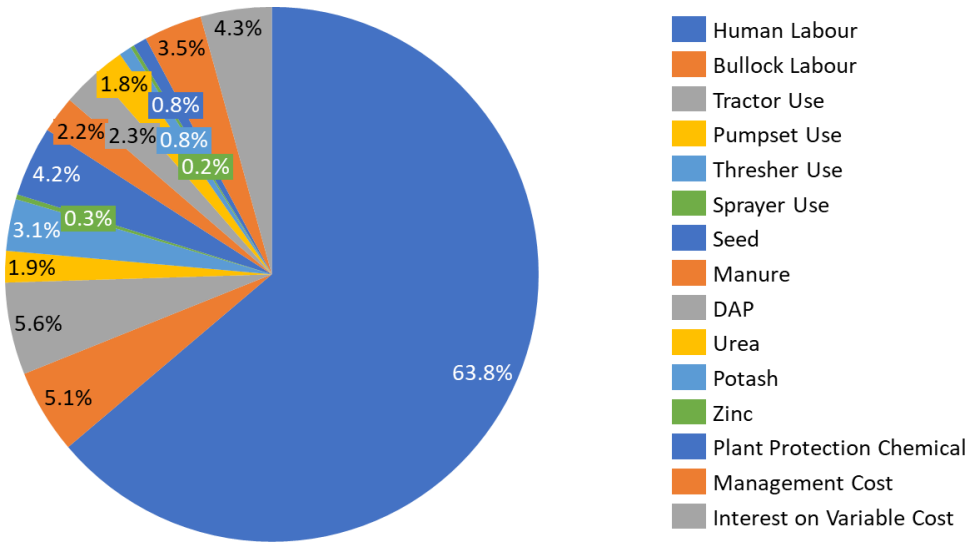

Fig. 4. Average Cost of Production of rice across 42 districts (Source: Author's Survey, Ministry of Agriculture and Livestock Development)

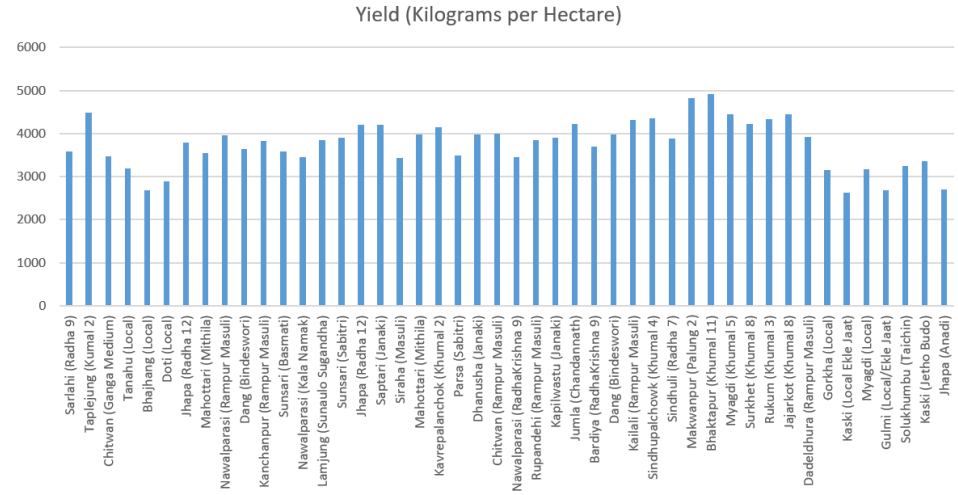

Fig. 5. Yield of rice across 42 districts (Source: Author's Survey, Ministry of Agriculture and Livestock Development)

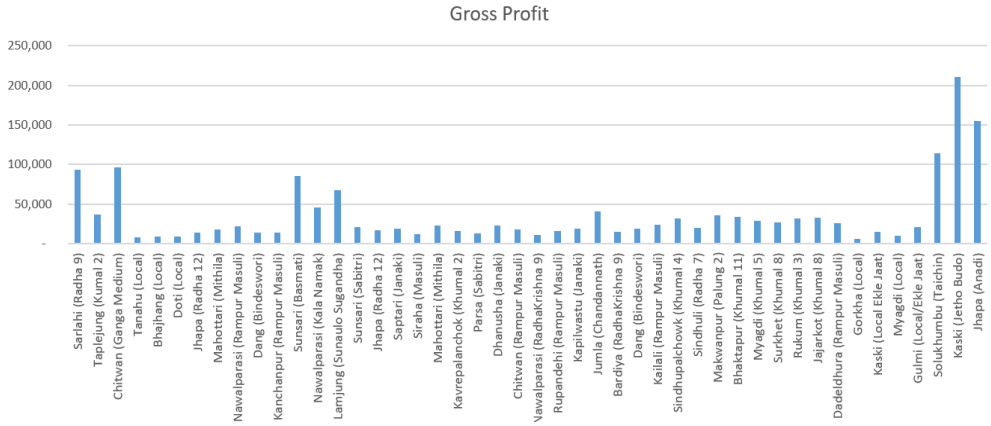

Fig. 6. Gross Profit of rice across 42 districts (Source: Author's Survey, Ministry of Agriculture and Livestock Development)

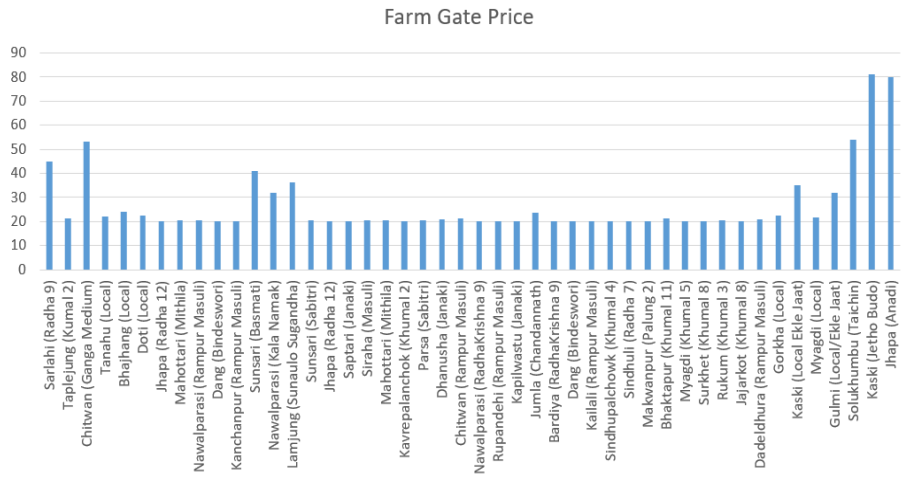

Fig. 7. Farm Gate price of rice across 42 districts (Source: Author's Survey, Ministry of Agriculture and Livestock Development)

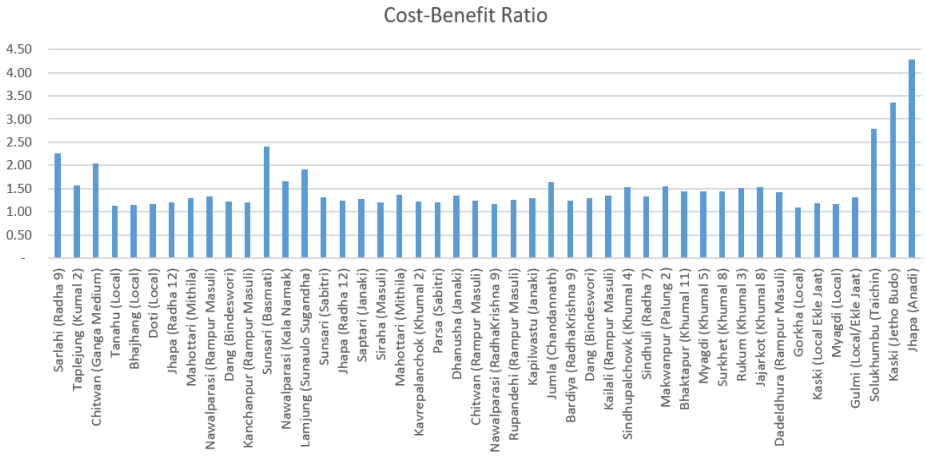

Fig. 8. Cost-Benefit ratio of rice across 42 districts (Source: Author's Survey, Ministry of Agriculture and Livestock Development)

Regarding profit, there are vast discrepancies between different rice varieties. Among conventional rice varieties, *Ganga medium* (Chitwan) cultivation provides a farm-gate gross profit (per hectare) that is 14.73 times greater than the profit derived from *Gorkha local.* When considering indigenous rice varieties, a notable divergence becomes more apparent. The gross profit margin of *Jetho Budo* rice stands out significantly, being 32 times greater than that of Gorkha local and 2.18 times that of *Ganga Medium*.

Among the non-landrace varieties, the *Ganga medium* variety commands the highest market price per kilogram, followed by *Radha 9*, while local varieties from Gorkha and Tanahun attract the lowest price. Indigenous rice varieties command notably higher market prices compared to their conventional counterparts. *Taichin* rice, for instance, is priced at NPR 180 per kilogram, while Anadi rice and *Jetho budo* rice fetch even higher prices at NPR 270 per kilogram each.

Taichin and *Anadi* hail from Eastern Nepal, while *Jetho Budo* originates from the Central Hills of Nepal. Notably, *Jumli Marsi*, a variety from the far western district of Jumla, commands a market price of approximately NPR 300 per kilogram. This particular variety serves as an example of the potential for other Marsi rice varieties from the eastern hills of Nepal. With strategic branding and marketing, these varieties have the opportunity to establish a presence in both national and international markets, similar to the success achieved by the *Jumli Marsi* variety. This highlights the immense potential within the diverse landrace rice varieties of Nepal, emphasizing the need for efforts in identification, categorization based on their unique characteristics, and proactive promotion at both the national and international levels.

3.3 Cost Benefit Analysis

The cost-benefit analysis was conducted after an in-depth examination of the production costs associated with 46 distinct rice varieties spanning 42 districts within Nepal. The farm gate price, expressed as a percentage of the market price, exhibited a range from 84.21 percent to a maximum of 92.61 percent for all varieties, excluding *Taichin*, *Jetho budo*, and *Anadi rice*. For these three particular varieties, the percentage was conservatively estimated at 30 percent, accounting for additional expenses incurred in transportation, branding, and packaging, as evidenced in a value chain study of *Jumli Marsi* rice conducted in the western hills of Nepal.

Despite adopting this conservative assumption, the cost-benefit ratio of these indigenous landrace rice varieties conspicuously surpasses that of conventional rice varieties, underscoring their economic viability. The discernible variance in the cost-benefit ratio can be attributed to the high pricing of these varieties within the premium rice market of Nepal. The conventional rice varieties command market prices ranging from NPR 22.35 to NPR 60 per kilogram. In stark contrast, *Taichin*, *Anadi*, and *Jetho Budo* rice exhibit significantly higher market prices, standing at NPR 180, NPR 270, and NPR 270

per kilogram, respectively[1]. This considerable discrepancy in market prices contributes significantly to the differential cost-benefit ratios observed among these varieties, underscoring the influence of market dynamics on the economic outcome of the rice cultivars.

4. CONCLUSION AND RECOMMENDATION

Hence, the potential disruption of this cyclic pattern could be achieved through the creation of enhanced income opportunities, exemplified by initiatives such as the promotion of premium rice varieties on the terraces of Nepalese hills. The Cordillera Rice Terraces in the Philippines, the Jatiluwih Rice Terraces in Indonesia, and the Honghe Hani Rice Terraces in China have garnered global recognition as designated World Heritage Sites, celebrated for their distinctive ecological, aesthetic, cultural, and economic significance. Consequently, the cultivation of premium varieties of rice in the hills, reinforced through strategic promotion, branding, and marketing, is an exceptional opportunity that holds promise for concurrently achieving the triple objectives of ecological preservation, income generation, and reduction of migration.

Below are some recommendations to attain these threefold objectives:

- **Cooperatives-based rice production:** The primary advantage associated with adopting a cooperative model lies in the generation of substantial volume, thereby enhancing the bargaining power of farmers. Due to the accumulation of volume, this model also creates opportunities for strategic branding and marketing initiatives. Cooperatives' efficacy in improving the agricultural sector is demonstrated by their role in assisting farmers in acquiring knowledge of Good Agricultural Practices (GAPs), providing informed pricing for their agricultural produce, facilitating improved technology adoption, effectively managing agricultural risks, and optimizing input [27]. Consequently, the formation of cooperatives is poised to contribute to an increase in agricultural yield, thereby fostering a positive impact on the financial gains of participating farmers. Moreover, another significant advantage conferred by cooperatives is the freedom from the obligation to sell surplus production at disproportionately reduced prices. This is particularly noteworthy, as cooperatives possess the ability to absorb excess volumes, thereby mitigating the adverse effects of market oversaturation and ensuring a more equitable price for the farmers. Consequently, it is recommended that farmers residing in the hilly region of Nepal consider the formation of a cooperative as a strategic initiative. Such a collaborative endeavor holds the promise of securing better pricing for their agricultural products, fostering opportunities for mechanization, and thereby, enhancing the overall profits of the member farmers.
- **Strengthen linkages with input suppliers, traders, millers and wholesalers:** Following the findings of the present study and analogous research endeavors conducted in Nepal, it has been found that the horizontal and vertical linkages within the hill regions are comparatively less robust in comparison to the terai districts. Consequently, it is recommended that multistakeholder workshops be organized to foster connections among rice farmers in the hilly areas and key stakeholders, including input suppliers, millers, traders, and other facilitators within the value chain. The establishment of such linkages is poised to cultivate a niche market, fostering mutual benefits for all participants within the value chain.
- **Government policy to support and promote these varieties:** Collaborative efforts among governmental entities, particularly the Ministry of Agriculture & Livestock Development, Ministry of Industry, Commerce & Supplies, and Ministry of Land Management, Cooperatives and Poverty Alleviation, are imperative to formulate and implement conducive policies. Such policies should be tailored to benefit farmers, Small and Medium Enterprises (SMEs) associated with the agricultural sector, as well as traders and other stakeholders operating within the broader spectrum of the value chain.
- **Attention of I/NGOs to support and promote these varieties:** I/NGOs are urged to direct their efforts towards the initiation of projects aimed at addressing

[1] *https://www.daraz.com.np/*

the interlinked challenges associated with migration, land use, water resources, and income generation. Strategic interventions in areas encompassing capacity development, facilitation of business-to-business linkages, and implementation of branding and marketing initiatives—potentially through events such as trade fairs—should be prioritized.

- **Geographical Indication (GI) certifications and Blockchain:** The indigenous rice varieties cultivated in the hills of Nepal hold substantial potential to attain global recognition akin to renowned rice varieties such as Basmati from India and Jasmine from Thailand. A strategic avenue for achieving this distinction involves obtaining GI certifications, which can serve as a valuable tool for establishing the unique identity and quality of these Nepalese landrace rice varieties in the global market. Furthermore, the integration of blockchain technology stands as a transformative technology within international commodity value chains. The adoption of blockchain in the cultivation and trade of Nepalese landrace rice varieties can enhance transparency, traceability, and overall efficiency, thereby positioning these varieties favorably in the international marketplace.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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