# Human–AI Interfaces for Bhutan's Rural Development: Insights from the Shingkhar Dairy Cooperative

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How can humans meaningfully co-exist with AI, instead of being swayed by its momentum? This is a pressing issue because AI can generate ideas and content round the clock, spontaneously, and fluently, by detecting patterns in large volumes of unstructured data.

Moreover, through increasingly autonomous systems, AI is expected to be utilised for a growing variety of practical tasks on behalf of humans. Its perceived usefulness as a reliable and readily accessible source may insidiously foster overdependence and, in turn, erode human capacities for critical judgement as well as independent reasoning and action.

This paper explores how human–AI interfaces should be designed to support rural development in Bhutan without encouraging excessive dependence on AI. For this purpose, it draws on the case of a dairy cooperative in Shingkhar (Ura Gewog, Bumthang).

The author was involved in its establishment between 2018 and 2021. At that time, AI was not widely used and none of the project stakeholders employed it.

At present, on the contrary, the technology can be drawn on to address issues surrounding the cooperative, such as streamlining its operations and developing new products.

The cooperative was profitable from its very first month, and local dairy farmers have continued to earn a stable cash income from milk sales. Its performance can be attributed to the tacit awareness among Shingkharpas, both within and outside the village, of the need for collaboration to ensure the cooperative's success (Masaki et al., 2021).

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The cooperative operates in a highland community situated at the far end of Bumthang, a location conducive to nurturing a habitus of reciprocity and shared responsibility cultivated over years of sustaining local livelihoods.

To reach Chamkhar, the central town of Bumthang, villagers must travel by road for about two hours, beginning with a non-blacktopped stretch before reaching the highway.

The high altitude also limits the quantity of milk that cows can produce, even during the summer. Consequently, the cooperative's profits remain modest compared with those of a well-established cooperative located near Chamkhar, which has a larger membership and access to a greater number of customers.

To consider how AI can be integrated in ways to complement rather than displace the stewardship of the Shingkharpas, it is useful to draw on a framework proposed by Max Tegmark (2019, 44–46), a leading scholar on AI safety research: "A decent earning, a sense of purpose, and meaningful fraternity" will remain central to human flourishing in the age of AI.

The three conditions are particularly relevant to rural development in Bhutan, requiring income generation, vibrant community relationships, and collective agency. Using the case of Shingkhar's cooperative, this paper examines how AI can assist in rural development while highlighting the need to preserve and further strengthen locally grounded participation and social cohesion.

## Building the Shingkhar Dairy Cooperative

The establishment of a dairy cooperative had long been hoped for by the residents of Shingkhar. Most households raised cattle and believed that forming a dairy cooperative would create access to markets for their cheese and butter, thereby providing stable and regular earnings.

At the time, dairy farmers mainly produced these products for household consumption, as gifts, and for religious offerings, while surplus products were sold only occasionally, usually in response to requests from visitors and acquaintances.

In 2016, in collaboration with some Shinkharpas based in the capital city, Thimphu, the author applied for the Japan International Cooperation Agency's (JICA's) support. With the approval of the agency and the Royal Government of Bhutan (RGOB), the cooperative began operations in August 2018 and made a net profit from the start. The cooperative draws its members from households in the village and makes monthly payments for the milk they supplied to the factory.

In line with the tradition of Shingkharpas' translocal ties, those residing elsewhere played crucial roles in enabling the cooperative to establish itself in its formative days.

A Shingkharpa based in Thimphu, not only drafted the cooperative's articles of association, but also used his graphic skills to design a label for butter. Another living in Chamkhar prepared bookkeeping formats for the operators, as well as arranged for Shingkhar-made products to be sold both in a shop near his residence and at the weekly Sunday market. Yet another residing in the vicinity of Chamkhar arranged training for the operators at the well-established cooperative referred to above.

The cooperative's success also hinged on compromises and goodwill of both the factory operators and the members, Shingkharpas based in the village. Among the two parties, the members acted proactively to forego their hope to have the milk rate raised and thus showed concern over the working conditions of the operators, who were selected from among local farmers.

The members subsequently raised the salary several times, reaching Nu. 8,250 in October 2019-- a 65 percent increase within just 15 months of the cooperative's establishment. This was despite the need to maintain the milk rate amidst uncertainty surrounding the project's financial sustainability. Some of the members, after supplying milk to the cooperative, also helped the operators produce cheese and butter.

## What AI Can Contribute: Envisioning Human-AI Collaboration

The cooperative has assumed greater importance as a source of stable and regular income in Shingkhar. The number of milk-supplying dairy farmers has increased from 31 to 34, all of whom now own more milking cows than before.

As a result, the cooperative's total daily milk supply in summer has increased from around 300 litres in 2018 to more than 600 litres today.

AI can help improve the efficiency of the cooperative's operations, thus contributing to lessening the burden on the operators who must balance their factory work with their own farming, livestock-related activities, and other household responsibilities. Although the realisation of this potential may be constrained by unstable network connectivity and unreliable electricity supply, several possibilities can nevertheless be identified.

One major area for potential AI intervention is equipment maintenance. The milk separator, which produces cream and skim milk for butter and cheese respectively, occasionally malfunctions.

This can be attributed to a combination of maintenance and operating practices. Milk residues can accumulate in small passages and other components, making thorough cleaning essential to prevent clogging and reduced performance. Moreover, the efficiency of the separation process is affected by the temperature of the milk, which can cause the separator to function improperly or become clogged.

At present, whenever equipment problems occur, the Shingkharpa based near Chamkhar provides advice by phone and, when necessary, visits the village to provide on-site assistance.

An AI-assisted equipment maintenance and troubleshooting system can reduce this dependence by systematically recording equipment symptoms, causes, and solutions and converting this accumulated knowledge into troubleshooting guidelines. When the operators encounter equipment problems, they can consult the system via a smartphone and receive step-by-step guidance based on past records.

The system can also automate maintenance schedules and send notifications when routine servicing is due. While more serious or unfamiliar breakdowns may still require external technical support, such a system can reduce the frequency of phone calls and visits and help retain technical knowledge within the cooperative. This should help streamline the operators' work at the factory.

There is also scope for introducing smartphone-based data entry, allowing AI to work in the background to organise, reconcile, and interpret basic information on milk supply, dairy production, sales, expenses, and payments owed to the members.

At present, multiple notebooks are used to record and manage this information. Such an AI-assisted system can lessen the administrative workload by helping the operators to ensure the accuracy and consistency of data consolidation. It should also contain the need to attend to members' inquiries about their individual accounts and other matters of concern.

The latter prospect must nevertheless be qualified, as some members may prefer the current practice, particularly those with limited digital literacy. For them, it remains easier, when the need arises, to ask the operators to search through the notebooks and manually double-check the relevant information.

Moreover, enabling the members to use their smartphones to gain direct access to relevant data may, paradoxically, create a new hurdle, as it would require them to acquire digital skills that are not currently necessary.

Beyond this challenge associated with digitalisation, the cooperative may struggle to remain competitive in local markets, which can become saturated if other nearby communities seek to replicate Shingkhar's success in their own areas.

In such a case, the cooperative will need to diversify its portfolio by introducing new products, such as yogurt and aged cheese. To explore such possibilities, the cooperative may require assistance from external agencies, which, in turn, calls for the preparation of funding proposals.

Against this backdrop, AI may be used to facilitate this process by helping to prepare application materials rapidly once the necessary information is provided, such as the cooperative's background, proposed activities, financial requirements, expected outcomes, and implementation plans. AI can reduce the time and effort required to draft such a proposal, thus lowering the barriers to applying for external assistance.

Moreover, the cooperative can draw on AI to make better use of the resources it obtains. Yogurt and aged cheese may open up broader markets by attracting new customer segments, including urban consumers and even international visitors to Bhutan.

In this respect, AI can assist in designing product labels, preparing promotional materials, creating social media content, and telling the cooperative's story in ways that appeal to potential customers. Such support for marketing and communication can help the cooperative build a brand identity, reach new markets, and convert external assistance into viable commercial opportunities.

## What AI Cannot Replace: The Human Foundations of Collaboration

The prospect of the cooperative's continued success should not be attributed solely to AI's potential to streamline its operations and assist with funding application and product diversification. The cooperative's future will also depend on Shingkharpas' continued retention of the tacit disposition toward reciprocity and shared responsibility.

The Shingkharpas' habitus enabled them to have the confidence to start the cooperative amid uncertainty and to seek to overcome challenges collectively in running it in the high-altitude community, without easy access to market centres. AI has no role in nurturing this attribute, given its lack of embodied, emotionally grounded participation in social life.

Even if AI succeeds in reducing the operators' workload, the positions are envisaged to rotate among villagers. Operating the dairy cooperative will still entail juggling factory work with other responsibilities. This double burden has resulted in frequent turnover of the operators.

The smooth continuation of the de facto "rotation system" will require villagers to retain a collaborative mindset and a willingness to take on the role when they have relatively sufficient labour capacity within their households. Such mutual support will be essential to maintaining a stable and regular source of income for villagers through milk production.

The new remuneration system, introduced in July 2022, replaced the fixed salary system with a lease-based arrangement that gives the operators a direct incentive to increase production and sales. As a result, each operator's monthly earnings have increased to approximately Nu. 10,000–15,000 during the summer months. While this is comparable to the earnings of workers at the established cooperative near Chamkhar, it is not sufficiently lucrative to compensate for the workload involved in operating the factory.

Given the additional burden this places on daily life, dairy farmers may find it more attractive to focus on supplying milk, which can generate a monthly income of Nu. 10,000–40,000 during the summer months.

Moreover, the involvement of Shingkharpas living elsewhere will continue to be essential for sustaining the cooperative's operations. Their support will be vital if the cooperative seeks to introduce new products, just as it was instrumental in securing JICA funding and establishing the cooperative in its early stages.

The members residing in the village have limited access to information about external funding opportunities and are unfamiliar with the requirements for submitting funding applications. In addition, the cooperative's product diversification and exploration of new market segments will also mandate support from Shingkharpas residing elsewhere, who have greater exposure to extra-local markets.

In the distant future, with advances in agentic AI and robotics, these technologies may eventually have the potential to produce cheese and butter and to coordinate milk collection and processing.

Should this become a reality, it could substantially lessen the burden on the operators, whose roles could increasingly shift from routine tasks to activities requiring human judgement and interpersonal relationships, such as quality control, problem-solving, and maintaining relationships with milk suppliers and customers.

Even so, AI could by no means substitute for the social processes that have developed among the Shingkharpas, through which reciprocity and shared responsibility have been cultivated over years of community practice to sustain rural livelihoods.

These processes should remain indispensable to the long-term sustainability of the cooperative as well as to the wellbeing of the Shingkharpas themselves. The latter is closely associated with their sense of conviviality they derive from having successfully established and sustained their own system of dairy production.

AI could not reproduce the social relationships and moral commitments through which durable collaboration is constituted and sustained.

## Conclusion: Augmenting Rather Than Displacing Human Capacities

The case of Shingkhar's dairy cooperative attests to the viability of Tegmark's three conditions essential for human-AI interfaces, referred to at the start of this paper- "a decent income, a sense of purpose, and meaningful fraternity".

The cooperative's success has relied on, and will continue to hinge on the Shingkharpas' willingness to compromise, volunteer their labour, support one another, and work collectively toward a shared future. Accordingly, the cooperative has not only created, but will continue to provide a stable and regular source of income in Shingkhar. It has also fostered a sense of purpose through this collective endeavour and will continue to strengthen the social bonds that sustain it.

The following broader implications can be drawn in the context of Bhutan's rural development:

1. AI can be effectively employed to automate administrative work, streamline operational procedures, facilitate access to external resources, and strengthen the capacity of communities to develop and sustain local initiatives.
2. At the same time, a sphere of human autonomy should be preserved to nurture and sustain the relationships and moral commitments that make collective action possible.
3. Such human stewardship enables rural residents not only to enhance their livelihoods but also to cultivate a sense of purpose and fraternity -- the very human capacities that remain indispensable in an age of advanced AI.

The case of Shingkhar's dairy cooperative suggests that the future of AI in rural Bhutan will depend less on what the technology can do than on how people choose to incorporate it into the social relationships through which they deliberate and collaborate toward shared goals.

While AI can enhance efficiency in administrative, analytical, and operational tasks, its deployment should ultimately reinforce -- rather than displace -- the trust, reciprocity, shared responsibility, and collective agency through which rural communities sustain their livelihoods. In this way, AI can contribute to rural development on Bhutan's own terms, in harmony with the GNH vision, which places community vitality at the heart of human wellbeing.

**Note on the Use of AI:** In drafting this paper, I used ChatGPT primarily to check the accuracy of my descriptions of recent technical developments. I did not use AI to generate ideas of substantive content. All analyses, interpretations, arguments, and conclusions are my own.

## References

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