

Promoting Ecological Modernization through Nature-Positive Business Models: A Case Study of Agricultural Sustainability in Ranigunj, Nepal

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Abstract

This study explores the potential of nature-positive business models and ecological modernization frameworks to address the dual challenges of soil degradation and heightened production costs in the agriculture sector in Ranigunj, Sarlahi, Nepal. Through a desk review and qualitative case study approach, the research identifies eco-friendly technologies such as biochar, microbial bio-fertilizers, vermicomposting, smart irrigation systems, biointensive agriculture, and the System of Rice Intensification (SRI) to address the challenges being faced by Ranigunj. The study also designs a phase-based five-year project as an implementation modality of the concept. Findings suggest that integrating these technologies can restore soil health, reduce input costs, and enhance livelihood resilience while aligning with global sustainability goals. The study presents practical alternatives for policymakers, agricultural practitioners, and researchers working in similar agro-ecological contexts in Nepal and beyond.

Keywords: Ecological modernization, nature-positive business, soil degradation, sustainable agriculture, Ranigunj

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INTRODUCTION

The global environmental emergency has catalyzed the development of diverse theoretical and practical approaches directed to addressing the tradeoff challenge between economic development and ecological sustainability. Among these approaches, Ecological Modernization and Nature-Positive Business have emerged as prominent frameworks to boost up the integration of environmental goals into industrial and agricultural systems (Mol & Sonnenfeld, 2000). Ecological

Modernization, originating in the 1980s, suggests that environmental crises can be mitigated through technological innovation, economic restructuring, and political will without compromising industrial progress (Gibbs, 2017). Extending this concept, Nature-Positive Business shifts the focus from merely minimizing harm to actively regenerating and enhancing natural systems (IUCN, 2023).

In Nepal, agriculture remains a cornerstone of livelihoods of rural as well as urban population and the national economy.

However, agricultural sector like in Ranigunj Sarlahi faces severe challenges characterized by soil fertility decline and expensive production costs.

The global environmental emergency has catalyzed the development of diverse theoretical and practical approaches, such as Ecological Modernization and Nature-Positive Business, directed toward addressing the tradeoff between economic development and ecological sustainability. In Nepal, where agriculture is a cornerstone of the economy, sectors like that in Ranigunj, Sarlahi, face severe challenges of soil fertility decline and expensive production costs. Therefore, this study addresses the research problem of how nature-positive business models and ecological modernization principles can be applied to revitalize degraded soil quality and ensure economic viability for smallholder farmers in Ranigunj. This is pursued through three key objectives: to identify the key environmental and socio-economic challenges affecting agricultural livelihoods in Ranigunj; to explore appropriate, context-suited nature-positive technological interventions; and to propose a participatory implementation framework for adopting these technologies to reconcile environmental conservation with enhanced agricultural productivity.

REVIEW OF LITERATURE

The theoretical foundation of this study is built in concepts of Ecological Modernization and the emerging paradigm of Nature-Positive Business. Ecological Modernization emphasizes the role of innovation, market mechanisms, and policy in achieving environmental reform (Mol & Sonnenfeld, 2000). Recent studies have extended this

to include business models that not only reduce harm but also contribute positively to biodiversity and ecosystem services (Baggaley et al., 2023).

In agricultural contexts, several technologies align with these frameworks: Biochar, a carbon-rich soil amendment, enhances water retention, nutrient availability, and long-term carbon sequestration (Lehmann et al., 2006). Microbial Bio-fertilizers introduce beneficial microorganisms to improve soil fertility and reduce dependency on chemical inputs (Choudhary & Yadav, 2021). Vermicomposting transforms organic waste into nutrient-dense fertilizer, improving soil structure and microbial health (Sherman, n.d.). Precision Agriculture Technologies, including IoT-based sensors, enables efficient resource use by providing real-time soil and crop data (Sheikh Mansoor et al., 2025). Biointensive Agriculture focuses on maximizing yields from minimal land through organic practices, composting, and companion planting (Jeavons, 2001). System of Rice Intensification (SRI) promotes altered water, seed, and soil management to increase rice yields while reducing inputs (Uphoff, 2015). Despite their documented benefits, the localized application of these technologies in Nepalese contexts like Ranigunj remains underexplored, presenting a significant research gap.

RESEARCH METHODS

This study adopts a qualitative case study approach, focusing on Ranigunj, Ward No. 17 of Lalbandi Municipality in Sarlahi District. Data collection methods included:

- Desk Study: Reviewed the literature on nature positive business.

- **Field Observations:** Conducted during september 2025 to assess cropping patterns, and soil conditions.
- **Semi-Structured Interviews:** Conducted during september 2025 and conducted informal interview with a few farmers (e.g., Shankar Paudel, Birendra Mahato) to identify the core problems they are facing and adaptation capacities.
- **Participatory Design:** Development of a “Nature-Positive Menu” of interventions through iterative community engagement and realistic approaches guided by realism.

The study is interpretive in nature, aiming to provide contextualized, practical solutions rather than generalizable statistical findings.

DATA ANALYSIS AND DISCUSSION

Contextual Challenges in Ranigunj

Ranigunj’s farmers are facing mainly two fold problem in terms of agriculture. This represents paradism shifts practice and behaviour for agricultural systems in Ranigunj. The first problem is the soil degradation caused by the excessive use of chemical fertilizers. Up to two decades back and the second is decline in organic manure use in one hand and farmers are facing unaffordable rise in agricultural production cost caused by increased mechanization, input costs, and labor expenses. This has distracted youths from agriculture and adopted outmigration for income opportunities. People have left cattle rearing and in order to fulfill the need of manure, they have been using quick fix

approaches - use of chemical fertilizer. Next finding of the field interaction is the shift in selection of cropping varieties. People have left growing mustard, pulses, millets and have started growing hybrid maize.

Suitability of Proposed Technologies

Identification and Review of appropriate technologies: Several modern technologies and nature friendly approaches developed in recent decades have been successfully introduced across the world that can enhance the soil quality and reduce the costs of farming. Some of the cost-effective tools that restore soils and at the same time can lower production costs are explored and how they fit to address the problem of Ranigunj is presented below.

Biochar

Biochar is a versatile and reliable technology for agricultural and environmental remediation due to its unique physicochemical properties in terms of soil fertility, nutrient retention, and water holding capacity. As a stable carbon-rich material, biochar promotes plant growth and increases crop yields by enhancing microbial activity (Kabir et al., 2023). Biochar enhances soil structure, water retention, and nutrient holding. It reduces fertilizer needs and stores carbon for longer-term (Lehmann et al., 2006; Sirén, 2024). Trials in Maharashtra, India, using affordable pyrolyzers, raised yields dramatically while reducing the costs (Gadkari, 2025).

Biochar is a type of charcoal and it can be made cheaply by using local crop leftovers, hence directly contributes to lower the fertilizer costs. Therefore, as it can be produced cheaply by using local crop leftovers which makes it suitable for Ranigunj. As literature review shows that

biochar boosts fertility in degraded soils, it is useful for Ranigunj to address her dual problem of restoring the soil quality and lowering the producing cost.

Microbial Bio-fertilizers / Inoculants

Bio-fertilizers are living microbial inoculants of bacteria, algae, fungi alone or in combination and they augment the availability of nutrients to the plants. Bio-fertilizers in agriculture assumes special significance, particularly in the present context of increased cost of chemical fertilizer and their hazardous effects on soil health (Choudhary R.J. & Yadav N.K., 2021). These include beneficial microbes like *Rhizobium*, *Azotobacter*, and extremophiles. These boost nutrient cycle and reduce use of synthetic fertilizer as well as restore soil health (Grower Business, 2025; Start Us Insights, 2023). Therefore, these technologies present effective solutions to the existing problems of Ranigunj.

As the microbial bio-fertilizers increases the availability of the nutrients to the plants, it directly addresses the issue of degraded soil quality of Ranigunj. Introducing locally adapted microbial inoculants can revive soil fertility naturally and lower recurring input costs. Therefore, it seems to contribute both of the issues of Ranigunj - degraded soil quality and heightened production cost making it a viable alternative for addressing the problem.

Vermicomposting

The term vermicomposting means the use of earthworms for composting organic residues. Earthworms can consume practically all kinds of organic matter and they can eat their own body weight per day, e.g. 1 kg of worms can consume 1 kg of residues every day. The excreta (castings) of the

worms are rich in nitrate, available forms of P, K, Ca and Mg. (Misra et al., 2003). Vermicomposting, or worm composting, produces a rich organic soil amendment containing a diversity of plant nutrients and beneficial microorganisms. (Sherman, n.d.). Worm compost creates nutrient-rich castings, improves aeration, water retention, and boosts yield (Mittimind Farms, 2025).

Vermicomposting has been successfully practiced in different parts of Nepal. Krishi Patrika (Ashar 11, 2079) writes, “Lalit Thapa, from Tikapur Municipality-1 in Kailali, has been producing vermicompost for three years. According to Thapa, vermicompost has become very useful for commercial farmers recently because it increases the fertility of the soil.” He adds, “I produce 200 quintals of vermicompost annually. My current production cannot meet the demand,” he said. “Farmers are using vermicompost as organic fertilizer. Since vermicompost keeps the soil moist, it is very beneficial for the soil, according to vermicompost-producing farmers. Naresh Rawal says that because cow urine is used in making the vermicompost, it also helps reduce crop diseases.” This all indicate that vermicompost has a high demand and is a beneficial organic fertilizer that improves soil fertility, moisture, and overall plant health.

Vermicomposting is an easier and affordable solution to enhance soil quality and minimize production cost. As worms eat almost all types of organic contents, it's easier to grow both in urban and rural setting. In context of urban setting, kitchen waste and in context of rural setting cattle and human organic residue can be converted into valuable manure. Therefore, in the context of growing semi-urbanization of the socio-economic

life of Ranigunj, this technology offers a quite relevant solution to enrich organic soil contents at cheaper effort and price for Ranigunj. As simple bins can supply low-cost organic nutrients and revive soil by using compostable kitchen and farm waste, this technology can draw attention of the farmers of Ranigunj.

Smart Soil & Irrigation Tech (IoT, Sensors, Precision Tools)

Traditional farming methods which were effective for generations has now been struggling to meet rising food demands due to limitations in productivity, efficiency, and sustainability amid climate change and reduced productivity. Precision agriculture presents a viable solution by optimizing resource use, enhancing efficiency, and fostering sustainable practices through data-driven decision-making in support of technologies such as advanced sensors and Internet of Things (Sheikh Mansoor et al., 2025). Business Insider (2025) highlights the efficiency of IoT tools, “Soil sensors and IoT tools deliver real-time data on moisture, nutrients, and pH, enabling smarter irrigation and fertilizer use.

Smart Irrigation saves water and nutrients up to 30% (Farmout, 2025). Therefore, this technology seems to be beneficial to the peasants of the Ranigunj to reduce their irrigation cost. Even low-cost moisture sensors can help farmers decide when and how much to irrigate or fertilize to precisely irrigate and fertilize the land. It directly avoids the potential wastes of these sectors saving the costs for farmers.

Biointensive Agriculture

Biointensive agriculture is a sustainable organic farming system based on working

with the basic elements needed for life such as soil, water, air and sun to achieve maximum yields for increasing biodiversity and soil fertility (Slavikova, 2017). This system comprises of intensive mixed farming, which supports the principles of nutrient recycling and integrated pest management including double-digging, companion planting, composting, and open-pollinated seeds. It boosts yield, reduces water and input usage, as well as builds topsoil up to 60 times faster (Jeavons, 2001; Ecology Action, 1996). With biointensive farming it's possible to grow food using 67% - 88% less water, 50% - 100% less fertilizer and 99% less energy than commercial agriculture just by expending a fraction of the resources. These techniques can also produce 2 to 6 times more food, build the soil up to 60 times faster than in nature, if properly used (Folnović, 2015).

As biointensive agriculture utilizes organic methods in cultivation, it avoids use of synthetic fertilizers, pesticides, and other harmful chemicals. Rather, composting, crop rotation, cover cropping, and natural pest control techniques are used to maintain the health of the soil and prevent the build-up of pests and diseases. Therefore, this is an excellent example of nature positive intervention in agriculture sector.

Citations presented above explain that biointensive agriculture soil fertility, boosts yield, reduces water and input usage, and builds topsoil up to 60 times faster. These all are the direct need of Ranigunj. Under this farming, traditional plots is shifted to biointensive beds without help of no big equipment. Just smart layout and composting is used to improve yield while rebuilding soil and reducing costs, therefore, it is useful to

the marginalized farmers of Ranigunj.

System of Rice Intensification (SRI)

The System of Rice Intensification is an innovative method of cultivating rice that focuses on improving the growth conditions of both the plant and the soil rather than relying on external inputs. It emphasizes planting younger seedlings singly with wider spacing, keeping the soil moist but not continuously flooded, and using organic matter to improve fertility (Uphoff, 2015; Stoop, Uphoff, & Kassam, 2002). These practices stimulate stronger root systems, enhance soil microbial life, and reduce dependency on chemical fertilizers.

SRI has shown remarkable results worldwide. In trials across Asia and Africa, yields have increased by 20 - 100 percentage while reducing water use by 25 - 50 percentage and seed use by 80 - 90 percentage (Africare, Oxfam America, & WWF-ICRISAT, 2010). SRI has increased rice yields up to 41% in India and 2 times in Cambodia while reducing seeds, water, fertilizers, and cost (FAO; Varma, 2019). It also lowers production costs and enhances resilience to drought and pests (FAO, 2016). Farmers can grow more rice with less water, less seed, and fewer chemicals, making it both cost-effective and environmentally friendly.

Ranigunj's paddy fields can greatly benefit from SRI as it addresses the two main issues of the area such as high production costs and declining soil quality. By using less seed, water, and chemical fertilizers, peasants can reduce expenses while restoring soil health through organic amendments. SRI also requires no expensive machinery, making it accessible for smallholders. This approach can help farmers achieve higher yields and better returns while conserving water, hence,

holds the potential of attracting farmers of Ranigunj and fostering nature-positive agriculture.

Implementation Modality

A phase-wise, participatory five-year project is proposed to implement the above mentioned nature positive approaches which are as follows:

- Preparation: Development of training materials with local farmers.
- Orientation: Presenting a "Nature-Positive Menu" in community forums.
- Implementation: On-site training, demonstrations, and continuous support.
- Review: Annual participatory assessments to refine strategies.

Mainstreaming: Institutionalizing successful practices through local farmer networks.

Preparation Phase

- Development of training materials and packages consisting of six identified solutions: Biochar, Microbial Bio-fertilizers, Vermicomposting, Smart Soil and Irrigation Tech, Biointensive Agriculture, and System of Rice Intensification (SRI).
- Prepare easy to understand materials with local examples and demonstrations.

Orientation and Choice Phase

- Organize community meeting - Peasants Platform to present the "Nature-Positive Menu" in community forums.
- Discuss the identified solutions (Nature-Positive Menu) in peasants' platform.

Explain and interact each solution in detail, highlighting processes, costs, benefits, and local/individual suitability.

- Allow peasants to select their preferred alternatives based on their farm conditions and needs.

Implementation and Support Phase

- Provide on-site training and practical demonstrations on chosen technologies.
- Offer continuous technical support and field monitoring throughout the year.
- Ensure timely troubleshooting during implementation.
- Facilitate farmer-to-farmer learning platforms to share experiences and practices.

Review and Learning Phase

- Conduct a joint review with peasants at the end of each year.
- Share experiences, results, challenges, and lessons across the community.
- Document best practices and refine strategies for the next cycle.

Cycle Continuation Phase

- Repeat the process for five years.
- Gradually build peasants' knowledge, experience, and confidence in using nature-positive solutions.
- Enable farmers to identify the most suitable and cost-effective options for long-term adoption.

Sustainability Phase

- After five years, peasants will have practical experience and evidence of benefits.
- The best solutions shall have been mainstreamed as sustainable practices in Ranigunj.
- Local platforms and peer networks will continue to support adoption after the project period.

Alignment with Ecological Modernization and Nature-Positive Business

The integration of these technologies exemplifies Ecological Modernization by leveraging innovation within existing farming systems. Moreover, moving beyond “less harm” to “active restoration” aligns with the Nature-Positive Business ethos, contributing to IUCN’s goal of reversing biodiversity loss by 2030.

CONCLUSION AND IMPLICATIONS

This study demonstrates that the integration of Ecological Modernization principles and Nature-Positive Business models offers a viable pathway to address the intertwined challenges of soil degradation and economic hardship faced by smallholder farmers in Ranigunj. By proposing a context-specific “Nature-Positive Menu” of interventions—including biochar, vermicomposting, SRI, and biointensive agriculture—and a participatory, phased implementation framework, the research moves beyond theoretical discourse to provide a pragmatic blueprint. This approach aligns with Ecological Modernization by advocating for technological and procedural innovation within the agricultural system and fulfills the

Nature-Positive goal by shifting practices from input-intensive degradation to active soil regeneration. Ultimately, the proposed strategy seeks to dissolve the perceived trade-off between productivity and sustainability, ensuring ecological restoration and enhanced economic viability for the farming community.

Implications

For Local Agricultural Practice: The study provides a practical toolkit for farmers and local cooperatives in Ranigunj, advocating for a shift from chemical-dependent farming to a knowledge-intensive, regenerative system that can lower costs and rebuild soil capital over time.

For Theoretical Application: It advances the concepts of Ecological Modernization and Nature-Positive Business by grounding them in the specific socio-ecological context of smallholder agriculture, showing how these frameworks can be operationalized through low-cost, accessible technologies and community-led processes.

For Development Methodology:

The research underscores the critical importance of participatory design and iterative community engagement, validating that sustainable adoption of new technologies requires co-development and adaptation to local knowledge, resources, and priorities.

For Policy: The findings imply a need for agricultural policy and extension services in Nepal to move beyond input subsidies and promote integrated nature-positive packages, supporting decentralized innovation, farmer-to-farmer learning networks, and market linkages for organic produce.

For Future Research: The study highlights the necessity for longitudinal action research to monitor the long-term socio-economic and environmental impacts of the proposed interventions and to refine the implementation model for replication in other regions with similar agrarian challenges.

REFERENCES

- Aker, J. C. (2011). Dial “A” for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647. <https://doi.org/10.1111/j.1574-0862.2011.00545.x>
- Bhattacharyya, P., Roy, K. S., Neogi, S., Adhya, T. K., Rao, K. S., & Manna, M. C. (2020). Biofertilizers: Potential and constraints. *Advances in Agronomy*, 162, 111–163. <https://doi.org/10.1016/bs.agron.2020.02.003>
- Choudhary, R. S., & Yadav, N. K. (2021). Biofertilizers (Microbial Inoculants). *Just Agriculture*, 1(6). <https://justagriculture.in/files/newsletter/2021/feb/024.%20Biofertilizers%20%28Microbial%20Inoculants%29.pdf>
- Folnović, T. (2015, June 2). *Biointensive agriculture – A sustainable solution for growing food*. Agrivi . <https://www.agrivi.com/blog/biointensive-agriculture-a-sustainable-solution-for-growing-food/>
- Gebbers, R., & Adamchuk, V. I. (2010). Precision agriculture and food security. *Science*, 327(5967), 828–831 . <https://doi.org/10.1126/science.1183899>
- Kabir, E., Kim, K.-H., & Kwon, E. E. (2023). Biochar as a tool for the improvement of soil and environment. *Frontiers in Environmental Science*, 11. <https://doi.org/10.3389/fenvs.2023.1324533>
- Kassam, A., Friedrich, T., Derpsch, R., & Kienzle, J. (2019). Overview of the worldwide spread of conservation agriculture. *Field Actions Science Reports*, 12, 1–10.
- Misra, R. V., Roy, R. N., & Hiraoka, H. (2003). *On-farm composting methods* (Land and Water Discussion Paper No. 2). Food and Agriculture Organization of the United Nations. <https://www.fao.org/4/y5104e/y5104e08.htm>
- Mol, A. P. J., & Sonnenfeld, D. A. (2000). Ecological modernisation around the world: An introduction. *Environmental Politics*, 9(1), 1–14 . <https://doi.org/10.1080/09644010008414510>
- Popescu Slavikova, S. (2017, July 25). *Biointensive farming: The future of our food production system*. Greentumble . <https://greentumble.com/biointensive-farming-the-future-of-our-food-production-system>
- Postel, S. (2000). Redesigning irrigated agriculture. In P. H. Gleick (Ed.), *Water in crisis: Paths to sustainable water use* (pp. 223–237). Island Press.
- Pretty, J., & Bharucha, Z. P. (2015). Integrated pest management for sustainable intensification of agriculture in Asia and Africa. *Insects*, 6(1), 152–182 . <https://doi.org/10.3390/insects6010152>
- Sheikh Mansoor, S., Iqbal, S., Popescu, S. M., Kim, S. L., Chung, Y. S., & Baek, J.-H. (2025). Integration of smart sensors and IOT in precision agriculture: trends, challenges and future perspectives. *Frontiers in Plant Science*, 16, 1587869 . <https://pmc.ncbi.nlm.nih.gov/articles/PMC12116683/>
- Sherman, R. (n.d.). *Vermicomposting*. NC State Extension. <https://composting.ces.ncsu.edu/vermicomposting-2/>
- The Organic Farmer. (2024, August 27). *Explore 9 Innovative Organic Farming Techniques In Mittimind Farms*. Mittimind Farms . <https://mittimindfarms.com/organic-farming-techniques/>
- रासस. (2022, June 25). रासायनिक मलको विकल्पमा गड्यौला मल [Vermicompost as an alternative to chemical fertilizers]. *Krishipatrika* . <https://krishipatrika.com/2022/06/26138/>