

Perspective: The Regenerative Bioeconomy-A New Avenue for Medicinal and Aromatic Plants

Mahesh Mahadeo Kadam

Scientist, Marketing and Business Development, CSIR-CIMAP, Lucknow, India

SUMMARY

The global demand for botanicals, phytopharmaceuticals, and natural cosmetics is on an exponential trajectory, driven by the wellness economy, preventive healthcare, and a global pivot toward green chemistry. However, this growth traps the Medicinal and Aromatic Plant (MAP) sector in a critical biodiversity-economy paradox: conventional wild extraction accelerates species depletion, while conventional cultivation often triggers genetic erosion, monoculture expansion, and irreversible natural capital loss. Current market mechanisms efficiently price harvested biomass but systematically fail to internalize the loss of evolutionary potential, pollinator habitats, and ecosystem services. This perspective argues that the future of the MAP sector cannot be a binary choice between "wild conservation" or "commercial cultivation," nor is a mere "circular economy" sufficient. Instead, it demands a paradigm shift toward a Regenerative Bioeconomy a model where economic systems actively restore ecosystems. We outline how transitioning from crop-centric approaches to landscape-centric Regenerative Bioeconomy Clusters can align biodiversity stewardship, circular biomass utilization, and community bio-enterprises. By redefining institutional roles from mere technology generators to "Bioeconomy Architects" and unlocking futuristic revenue streams like biodiversity credits, the MAP sector can serve as a globally replicable model for sustainability transitions. Ultimately, we posit that commercialization, when structurally aligned with conservation, can cease to be the enemy of nature and instead become its most powerful engine for restoration.

INTRODUCTION

Medicinal and Aromatic Plants (MAPs) occupy a critical nexus of global healthcare, rural economics, and biodiversity conservation, yet their exponential market growth—driven by the wellness economy and green chemistry—traps the sector in a fundamental biodiversity-economy paradox. While shifting from destructive wild harvesting to cultivation is necessary to meet industry demands for standardized, traceable supply, conventional cultivation often triggers a secondary crisis of irreversible natural capital loss, characterized by genetic erosion, monoculture expansion, and the displacement of native pollinator habitats. Current market mechanisms efficiently price harvested biomass but systematically fail to internalize the loss of evolutionary potential and ecosystem services, meaning economic success inherently generates ecological pressure. Consequently, the future of the MAP sector cannot be a binary choice between wild conservation and commercial cultivation, nor is a mere "circular economy" sufficient; it demands an urgent paradigm shift toward a Regenerative Bioeconomy, where economic systems actively restore ecosystems. By transitioning from crop-centric approaches to landscape-centric Regenerative Bioeconomy Clusters that integrate biodiversity stewardship, circular biomass utilization, and emerging financial mechanisms like biodiversity credits, the MAP sector can resolve this foundational paradox, proving that commercialization, when structurally aligned with conservation, can become nature's most powerful engine for restoration.

Move 1: The Provocation – The Biodiversity-Economy Paradox

The global demand for botanicals, phytopharmaceuticals, and natural cosmetics is on an exponential trajectory, driven by an aging population, the wellness economy, and a global pivot toward green chemistry. However, the Medicinal and Aromatic Plant (MAP) sector is trapped in a structural paradox. Historically, valuable species follow a predictable, destructive lifecycle: wild discovery, rising market demand, overharvesting, and resource depletion. While shifting to cultivation is necessary to meet industry demands for predictable, standardized, and traceable supply, it introduces a secondary, often overlooked threat: irreversible natural capital loss. When aromatic crops become commercially successful, monocultures expand, native vegetation declines, elite varieties dominate, and traditional landraces disappear. Markets price the harvested biomass, but they systematically fail to price lost genes, diminished pollinator populations, or lost evolutionary potential. Economic success, in this conventional model, inherently creates ecological pressure.

Move 2: The Paradigm Shift – Beyond Extraction and Circularity

The future of the MAP sector cannot be a binary choice between "wild conservation" or "commercial cultivation." Nor is it sufficient to merely adopt a "circular economy" that focuses only on waste minimization. We propose a fundamental paradigm shift toward a **Regenerative Bioeconomy**.

The evolution of bio-based development has moved from *Extractive* (Forest → Market) to *Green* (Reduce harm) to *Circular* (Reuse → Recycle). The Regenerative Bioeconomy represents the next frontier: **Restore → Regenerate → Produce → Prosper → Reinvest in Nature**. The central principle is that every economic activity must leave ecosystems, soil health, water resources, and farmer livelihoods measurably better than before. In this model, biodiversity and ecosystem services are not externalities to be mitigated, but measurable, valued outputs alongside profit.

Move 3: The Mechanism – Why MAPs Are the Ideal Test Case

Among all agricultural sectors, MAPs are uniquely positioned to pioneer this transition. Biologically, many aromatic crops (e.g., lemongrass, vetiver, palmarosa) thrive in marginal, rainfed conditions, requiring minimal water. Ecologically, they integrate seamlessly into agroforestry and intercropping systems, and many are highly attractive to bees, butterflies, and beneficial insects, actively promoting pollinator activity. Economically, their high value per acre reduces the pressure to expand cultivation into ecologically sensitive frontiers.

To harness this potential, development must shift from a *crop-centric* to a *landscape-centric* approach. We introduce the **Regenerative Bioeconomy Cluster (RBC) Framework**. Instead of the linear model of *Research → Variety → Farmer → Oil → Market*, the RBC model operates as a closed-loop ecosystem: *Biodiversity Conservation → Farmer Cluster → Regenerative Processing → Branding → Ecosystem Restoration → Market*. Within these clusters, distillation residues become biochar, spent biomass becomes compost or biostimulants, and wild medicinal plant patches are maintained as biodiversity corridors within production landscapes.

Move 4: The Futuristic Frontier – New Revenue and Institutional Realignment

The most transformative avenue of the regenerative bioeconomy lies in redefining farmer revenue streams and institutional mandates. Currently, a farmer's income relies solely on crop sales. In a regenerative model, a farmer cultivating medicinal plants while maintaining pollinator habitats and soil carbon should earn from multiple streams: **Crop Revenue + Processing Income + Biodiversity Credits + Ecosystem Service Payments**. Global investors and multinational corporations are increasingly mandated to meet strict nature-positive supply chain commitments, creating a lucrative, untapped market for conservation-linked sourcing.

To actualize this, research institutions must evolve from being mere "technology generators" to "**Bioeconomy Architects**." We propose the **20-20-20-20-20 Rule** for institutional R&D allocation: effort must be equally distributed across (1) conservation biology, (2) germplasm characterization, (3) climate-resilient breeding, (4) farmer-centric cultivation systems, and (5) market development. Currently, 70–80% of institutional focus skews toward production, leaving conservation critically underfunded. To measure success, we must replace traditional Key Performance Indicators (e.g., "area cultivated") with the **Regenerative Bioeconomy Index (RBI)**, which tracks hectares restored, pollinator index improvements, and biodiversity-based enterprise creation.

Move 5: The Visionary Conclusion – Can Commercialization Conserve Nature?

The defining question for the MAP sector over the next three decades is not whether it will grow, but whether biodiversity will grow with it. If local communities are made the primary beneficiaries of maintaining medicinal plant landscapes, they transition from extractors to active conservationists. By integrating wild conservation, climate-smart cultivation, biotechnology, and community stewardship, India—and the global botanical sector—can establish a replicable blueprint.

The convergence of biodiversity, bioeconomy, and sustainable rural development is no longer a theoretical ideal; it is an operational imperative. When structured as a regenerative bioeconomy, commercialization does not have to be the enemy of nature. It can, and must, become its most powerful engine for restoration.

REFERENCES

- Chen, S. L., Yu, H. M., Luo, H. M., Wu, Q., Li, C. F., & Steinmetz, A. (2016). Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chinese Medicine*, 11(1), 37.
- Cunningham, A. B. (2014). *Applied Ethnobotany: A Practical Guide to the Collection and Use of Medicinal Plants*. Earthscan.

- Hamilton, A. C. (2008). Medicinal plants, conservation and climate change. *Biological Conservation*, 141(12), 2931-2932.
- Ved, D. K., & Goraya, G. S. (2017). *Demand and Supply of Medicinal Plants in India*. FRLHT, Bangalore & NMPB, New Delhi.
- Ved, D. K., Kinhal, G. A., & Bhat, R. K. (2021). Conservation status of medicinal plants in India: A comprehensive assessment and trade dynamics. *Journal of Ethnopharmacology*, 265, 113325.
- Bugge, M. M., Hansen, T., & Klitkou, A. (2016). Bioeconomy: Past, present and future. Nordic Council of Ministers.
- Ellen MacArthur Foundation. (2013). Towards the Circular Economy Vol. 1: Economic and business rationale for an accelerated transition.
- Giller, K. E., Hijbeek, R., Andersson, J. A., & Sumberg, J. (2021). Regenerative agriculture: an innovation for... *Nature Food*, 2(8), 599-602. (Crucial foundational text for defining "regenerative")
- Raworth, K. (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. Chelsea Green Publishing.
- Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. (2016). Business models for sustainability: Origins, present research, and an agenda for responsible, value-creating innovation. *Journal of Cleaner Production*, 139, 3-11.