Introduction to the Special Issue: Smallholder coffee in PNG

Technology, Ecology, and Livelihoods: Framing the Future of Smallholder Coffee in PNG

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ABSTRACT

Coffee is PNG's most significant agricultural export and the principal source of income for over 400,000 smallholder households. Yet despite its importance, the industry has experienced prolonged stagnation, declining quality, and the growing threat of coffee berry borer (CBB). Most PNG smallholders cultivate coffee in low-input, labour-constrained systems, where the crop is often secondary to food production and customary obligations. These realities demand approaches to industry renewal that differ from plantation or high-input models.

This special issue of the *PNG Coffee Journal* brings together contributions that examine technology, ecology, extension, and farmer perspectives in the smallholder sector. One paper evaluates demucilagers—mechanical wet mills that improve processing consistency and reduce labour demands—demonstrating their potential to enhance quality and support CBB management. Another explores the ecological benefits of shade management, including improved resilience, nutrient cycling, and income diversification. Two contributions present a new training package and the ten guiding principles underpinning it, emphasising low-input strategies, gender inclusion, and whole-farm systems approaches. The issue also includes an interview with industry practitioner and coffee pioneer, John Leahy, who provides a good dose of reality in what is possible in the PNG smallholder context.

Across these contributions, several themes emerge: the need for improved quality and consistency, the centrality of labour efficiency, the importance of agroecological sustainability, and the value of extension tailored to individual household contexts. Collectively, the papers highlight an integrated agenda linking technology, ecology, and social realities. The future of smallholder coffee in PNG will depend on aligning these dimensions in ways that improve quality, sustain livelihoods, and enable adaptation to emerging challenges.

INTRODUCTION

Coffee is one of the world's most important tropical commodities, supporting the livelihoods of around 25 million smallholder households globally. In PNG, coffee is the most significant agricultural export in terms of the numbers of farmers involved and is the principal source of

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income for over 400,000 smallholder families, who collectively produce around 85 per cent of national output.

Despite its importance, PNG's coffee industry has experienced prolonged stagnation. National production has not increased since the 1990s. The quality of exports has also deteriorated, with a shrinking share of premium-grade coffee reaching international markets. Several structural constraints underpin this decline: poor transport infrastructure, limited access to extension services, weak institutional support, and contested land tenure. More recently, the arrival of the coffee berry borer (CBB) in 2017 has introduced a major new threat to productivity and quality which has also undermined smallholder incentives to invest in their coffee gardens. These pressures are compounded by climate change, declining soil fertility, and fluctuations in international coffee prices.

Like for producers of other export crops in PNG, coffee is vital but rarely their sole or primary livelihood. As John Leahy observes in his interview in this issue, coffee is often a "backup crop" — a source of cash when food production falls short, but rarely prioritised above gardening and customary obligations. Coffee production is typically low-input and labour-constrained, shaped by household strategies that balance subsistence, cash cropping, and social responsibilities. Any attempt to revitalise the sector must therefore be grounded in the realities of these production systems, rather than in plantation or high-input models.

KNOWLEDGE GAPS AND THE NEED FOR INNOVATION

The challenges facing smallholder coffee are not new, but past responses have often not addressed the ecological and social contexts of farming families. Extension advice has frequently assumed a willingness and capacity to adopt high-input production practices, overlooking the cultural and economic logics of low-input systems. Furthermore, state-led extension has been underfunded and poorly resourced, with limited availability of training materials tailored to PNG conditions.

Research has also tended to isolate coffee from the broader livelihood systems in which it is embedded. As a result, important dimensions such as family labour, gender relations, shade management, nutrient recycling and interactions with other livelihoods like food marketing have been underexplored. Without attention to these dynamics, attempts at industry renewal risk reinforcing inequalities and overlooking key drivers of household strategies.

These limitations highlight the need for integrated approaches that address three interconnected domains:

1. Technology and processing — innovations that improve consistency and quality while reducing labour demands.
2. Ecology and agroforestry — practices that enhance sustainability, resilience, and ecosystem services.
3. Extension and training — farmer-centred approaches that reflect the low-input strategies, gender roles, and livelihood diversity of PNG households.

The contributions in this special issue speak directly to these domains, offering fresh insights into the future of smallholder coffee in PNG.

CONTRIBUTIONS OF THE SPECIAL ISSUE

Demucilagers and the potential for improved processing

The paper by Tobias Kumie and Timothy Sharp examines demucilager technology—small-scale mechanical wet mills that eliminate the need for fermentation. Inconsistent fermentation has long been a major source of poor quality in smallholder coffee. By producing clean parchment with minimal labour and water use, demucilagers generate more consistent quality and have achieved premium and specialty cupping scores. Importantly, the technology reduces processing time and labour, encouraging more regular harvesting, which is critical for managing CBB. Demucilagers therefore offer both economic and pest management benefits, positioning them as a promising innovation for PNG's smallholder sector.

Shade as a foundation for ecological resilience

Geraldine Tilden, George Curry, and Jonah Aranka explore the multiple benefits of well-managed shade. Although most PNG smallholders grow coffee under shade, management is often inadequate and the potential advantages under-recognised. Effective management of shade trees can synchronise flowering, improve cherry quality, suppress weeds, enhance nutrient cycling, and provide a buffer against weather extremes. They also provide opportunities for diversification through timber, firewood, and fruit production, and can facilitate certification. However, farmer surveys reveal substantial knowledge gaps, particularly around the timing of shade pruning and its implications for pests and diseases. Improved extension is therefore essential to unlock the full value of shaded coffee systems.

Extension package for a low-input system

The paper by Tilden, Aroga, and Curry introduces a comprehensive training package on smallholder coffee production in PNG developed by the Coffee Industry Corporation (CIC), Curtin University, and ACIAR. Comprising more than 20 modules, the package covers the full spectrum of production from nursery establishment to harvesting, processing, marketing, and financial management. Designed with PNG's low-input systems in mind, it adopts a whole-farm perspective that situates coffee within household livelihood strategies. The package emphasises labour efficiency, gender inclusivity, and sustainability, and employs a collaborative learning approach to actively engage farmers. By institutionalising a training-of-trainers model and aligning with certification standards, the package offers a scalable framework for strengthening extension capacity.

Ten guiding principles for effective training of farmers and cadet extension officers

Curry, Aroga, and Tilden articulate the principles underpinning the extension modules. These include recognition of the dominance of low-input strategies; the crucial role of women in harvesting and processing; the diversity of household contexts; the benefits of agroforestry and nutrient recycling; and recognition that CBB is here to stay and we must learn to live with it. They also stress the importance of farmer groups as the foundation for extension, and of linking farmers with exporters to create incentives for quality. Together, these principles provide a coherent framework for extension that is empirically grounded and can accommodate the realities of PNG smallholder coffee.

Gendered dimensions of smallholder coffee

Matilda Hamago's paper examines the often-overlooked gendered dynamics of agricultural extension. Drawing on interviews with female and male extension officers and women farmers, she shows how female smallholders often missed out on extension advice despite their labour being central to harvesting, processing and marketing. The paper highlights the need to move beyond treating gender as a peripheral concern in extension, instead recognising it as

fundamental to smallholder productivity and family welfare. Hamago's contribution expands the analytical frame of the special issue and signals pathways for more inclusive industry renewal.

An industry voice: interview with John Leahy

This issue also features an interview with a long-term industry insider, John Leahy, whose decades of experience working with smallholders, managing plantations and processing factories, provides a reality check for those seeking to transform smallholders into high input, capital intensive producers. John, who has lived and breathed coffee all his life, highlights the importance of consistency to meet international buyer requirements, the labour-saving benefits of shade, and the persistent barriers posed by land tenure disputes. He underscores the need for interventions to suit smallholder priorities, rather than imposing external models, noting that PNG smallholders will only adopt practices that align with their social and livelihood strategies.

THEMATIC SYNTHESIS

Across their diversity, the contributions to this special issue converge on several key themes.

Quality and consistency as prerequisites for value

Without improvements in quality, smallholders will remain excluded from higher-value markets. Demucilagers provide a technological pathway, while training modules and farmer–exporter partnerships can reinforce the knowledge and institutional support required.

Labour efficiency as a driver of adoption

In low-input systems, where labour is scarce and competing demands are high, innovations that reduce labour costs—whether in processing, coffee husbandry, especially harvesting—are most likely to succeed. As Hamago demonstrates, recognising women's labour and ensuring greater equity in returns are central to this goal.

Agroecological sustainability and resilience

Shade management and nutrient recycling highlight the potential for agroforestry to enhance both ecological functions and economic resilience. These strategies align well with smallholder preferences for low-cost, risk-minimising practices.

Extension tailored to social realities

Effective extension must accommodate the diversity of smallholder households, work through farmer groups, and build on existing practices. Private sector involvement through supply-chain partnerships and certification can enhance economic opportunities and returns for farmers.

Coffee as embedded in livelihood systems

Coffee must be understood as one component of a broader suite of livelihoods, rather than as a stand-alone crop. Practices that align with this reality—such as recognition of food gardening for household consumption and sale—are far more likely to be adopted than those that require radical restructuring of household priorities.

CONCLUSION

Smallholder coffee in PNG faces daunting challenges: stagnant production, declining quality, and the pervasive threat of CBB. Yet the contributions in this special issue demonstrate that pathways for renewal are possible. Technological innovations such as demucilagers, ecological practices centred on shade and nutrient recycling, and farmer-centred extension models all offer promising routes forward. Industry perspectives remind us that success ultimately depends on alignment with farmer realities and market requirements.

Revitalising PNG's smallholder coffee will not be achieved through any single intervention but through the integration of technology, ecology, and social context. The future of smallholder coffee will depend not only on improved agronomy and market access but also on more equitable participation and benefit-sharing within households and communities.