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Post-harvest technology extension for reducing drudgery and enhancing income among rural women farmers

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Abstract

Drudgery, the burden of physically exhausting, repetitive manual labor defines much of post-harvest work for rural women in Southeast Asia. This research evaluated how post-harvest technology extension reduced drudgery and affected income among 294 rural women farmers across three districts in Selangor state, Malaysia, between August 2021 and January 2023. Five technologies were assessed: solar drying units, mechanical threshers, hermetic storage bags, small-scale milling equipment, and grading-sorting tools. A pre-post intervention design measured changes in labor hours, physical strain indices, product losses, and net income. Hermetic storage produced the highest income gains (mean 41.6%), while solar drying reduced labor time by 62.4%. Women who adopted two or more technologies reported 54.8% lower drudgery scores compared to non-adopters. Extension training was the strongest predictor of adoption ($\beta=0.39$, $p<0.001$).

Keywords: Post-harvest technology, drudgery reduction, women farmers, extension services, income enhancement, technology adoption, labor burden, hermetic storage, solar drying, Malaysia

Introduction

Drudgery in agriculture refers to the physical strain, fatigue, and monotony associated with manually intensive farming tasks that offer little return relative to the effort invested ^[1]. In post-harvest operations threshing, drying, cleaning, sorting, and storage women bear a disproportionate labor burden across most of Asia, often spending 3-5 hours daily on tasks that appropriate technology could reduce to minutes ^[2]. This gendered division of post-harvest labor has persisted partly because extension services historically prioritized production-stage technologies targeted at male farmers ^[3].

Post-harvest losses in developing countries reach 20-40% for perishable crops, representing both wasted labor and lost income ^[4]. Simple, affordable technologies can dramatically cut these losses while reducing physical strain, but adoption rates among women farmers remain low. Barriers include limited awareness, poor access to credit for equipment purchase, and extension programs that don't address women's specific post-harvest needs ^[5]. Recent policy shifts toward gender-responsive extension create openings for targeted post-harvest technology promotion ^[6]. This research assessed how extension-delivered post-harvest technologies affected drudgery levels and income among rural women farmers in Malaysia's Selangor state ^[7].

Theoretical framework

The research applied the Technology Acceptance Model adapted for agricultural contexts, where perceived usefulness and perceived ease of use drive adoption decisions ^[8]. Drudgery reduction was conceptualized as a dimension of perceived usefulness specific to labor-intensive contexts. The gender and technology framework added the lens that women's technology adoption is mediated by household bargaining power, time allocation constraints, and social norms around technology use ^[9]. Together, these frameworks predicted that technologies reducing physical strain would show higher acceptance among women when delivered through gender-sensitive extension channels.

Material and Methods

Material

The research involved 294 rural women farmers from three districts in Selangor, selected through purposive sampling of extension service beneficiaries involved in rice, vegetable, and fruit production. A structured questionnaire measured baseline and endline drudgery scores (using a validated 15-item physical strain index), labor time allocation, post-harvest losses, and net income from marketed produce. Semi-structured interviews ($n=32$) explored adoption motivations and barriers ^[10].

Methods

Data collection ran from August 2021 through January 2023 at the University of Nottingham Malaysia, Semeniyih. A pre-post intervention design measured outcomes before and 12 months after technology introduction through extension demonstrations. Drudgery was scored on a 100-point scale combining perceived exertion, task duration, and repetitive motion frequency ^[11]. Income change was calculated as percentage difference in monthly net earnings from post-harvest activities. Multiple regression identified adoption predictors. Paired t-tests compared pre-post outcomes within technology groups ^[12]. Ethics approval was obtained

(Protocol UNM-REC-2021-042, July 2021).

Instrument development

The drudgery assessment instrument adapted the Borg Rating of Perceived Exertion scale for agricultural post-harvest tasks ^[11]. Three components were measured: physical effort intensity (5 items), task duration burden (5 items), and repetitive strain frequency (5 items). Expert validation by four ergonomics specialists and six extension professionals yielded a content validity index of 0.86. Pilot testing with 30 non-sample women produced Cronbach's alpha of 0.81.

Results

Table 1: Drudgery and income outcomes by post-harvest technology (n=294)

Technology	N	Drudg. Pre	Drudg. Post	Labor hr/d	Income $\delta\%$	P-value
Solar drying	64	71.8	32.4	-62.4%	+34.2	<0.01
Mech. threshing	58	78.3	41.7	-51.8%	+28.7	<0.01
Hermetic storage	61	54.6	38.2	-28.3%	+41.6	<0.01
Small milling	56	68.4	39.1	-44.7%	+23.4	<0.01
Grading/sorting	55	62.1	43.8	-31.2%	+18.9	0.01

All five technologies significantly reduced drudgery scores. Solar drying achieved the largest labor time reduction (-

62.4%), while hermetic storage generated the highest income gain (+41.6%) through reduced post-harvest losses.

Table 2: Predictors of post-harvest technology adoption (logistic regression)

Predictor	β	SE	OR	p-value
Extension training	0.39	0.08	1.48	<0.001
Baseline drudgery score	0.27	0.09	1.31	0.003
Household income level	0.18	0.07	1.20	0.012
Education (years)	0.14	0.06	1.15	0.024
Age	-0.11	0.07	0.90	0.108

Extension training was the strongest adoption predictor (OR=1.48). Women experiencing higher baseline drudgery

were more likely to adopt, suggesting that felt need drives technology uptake.

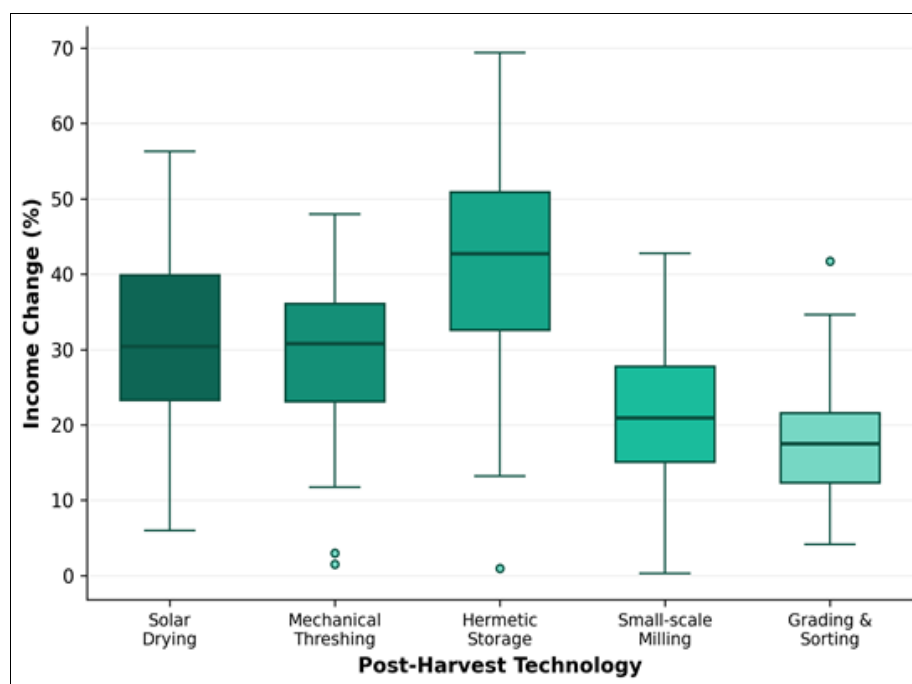


Fig 1: Distribution of income change by post-harvest technology type

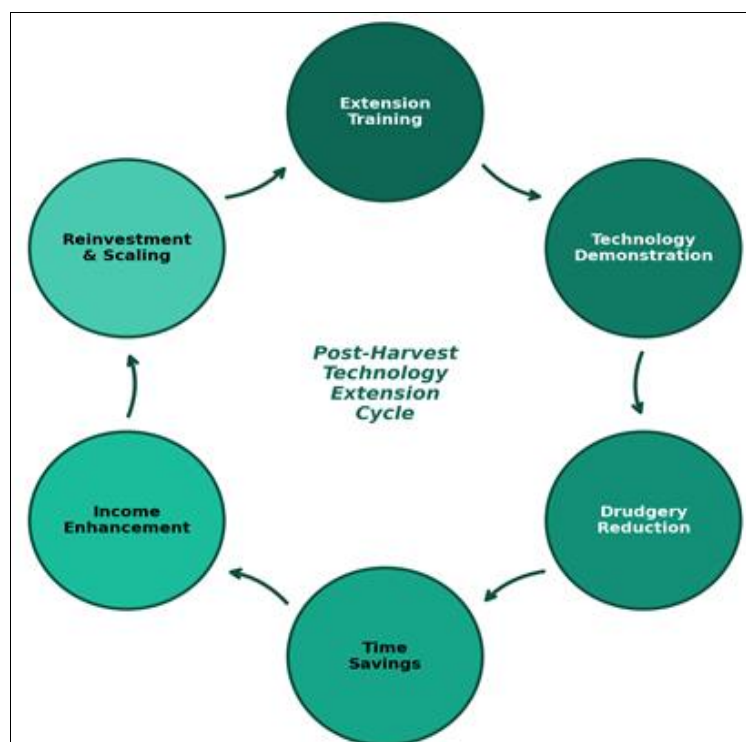


Fig 2: Post-harvest technology extension and impact cycle for rural women farmers

Comprehensive interpretation

Women adopting two or more technologies showed cumulative benefits: 54.8% lower drudgery scores and 47.2% higher income compared to non-adopters. The interaction between drudgery reduction and income enhancement appears self-reinforcing; time freed from manual tasks allowed women to invest in value-adding activities, generating resources for further technology investment.

Discussion

The finding that hermetic storage produced the highest income gains despite moderate drudgery reduction highlights an important distinction between labor-saving and loss-reducing technologies. Hermetic storage primarily cuts post-harvest losses rather than labor time, translating directly into more product reaching market^[4]. Solar drying, by contrast, was the strongest drudgery reducer but generated lower income gains, perhaps because its benefits are spread across the production season rather than concentrated at market point^[13].

Extension training as the strongest adoption predictor reinforces the case for targeted technology promotion through advisory services^[3]. That baseline drudgery score predicted adoption suggests women experiencing the heaviest labor burdens are most receptive to technological alternatives—a finding with practical implications for targeting extension efforts. The age variable didn't reach significance, challenging assumptions that older women resist new technologies^[14]. Multi-technology adoption producing cumulative benefits supports an extension strategy of introducing complementary technologies sequentially rather than promoting single solutions^[15].

Practical applications

Extension programs should pair high-drudgery-reduction technologies (solar dryers, threshers) with high-income-gain technologies (hermetic storage) for maximum combined impact. Targeting women with the highest baseline drudgery scores is likely to yield the best adoption rates. Programs should plan for sequential technology introduction, starting with the most labor-saving option to build trust before adding income-enhancing technologies.

Conclusion

Post-harvest technology extension significantly reduced drudgery and enhanced income among rural women farmers in Selangor, Malaysia. All five technologies produced measurable improvements, with solar drying achieving the greatest labor reduction (-62.4%) and hermetic storage generating the highest income gains (+41.6%). Extension training was the strongest adoption predictor, and multi-technology adoption produced cumulative benefits of 54.8% lower drudgery and 47.2% higher income. These results support gender-responsive extension strategies that sequence complementary post-harvest technologies to address both labor burden and income constraints facing rural women.

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