

Technological interventions to reduce the drudgery of women farmers in post-harvest operations of millets

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In view of addressing the problem of drudgery experienced by women farmers in traditional and improved millet post-harvest practices, including the use of power-operated machinery, a detailed analysis was carried out on millet post-harvest operations using relevant ergonomic parameters. The study involved 32 farm women from Chalki and Gangapur villages of Telangana state, who were beneficiaries of the Farmers FIRST Project. The findings revealed that threshing and winnowing were the most physically demanding and time-consuming operations under traditional practices. Adoption of improved technologies significantly reduced working hours, particularly in flatbread (chapatti) making and other millet post-harvest operations. Moreover, the use of improved machinery helped minimise health-related issues, enhanced work efficiency, increased productivity, and contributed to improve income generation and livelihood security of farm women.

Keywords: Drudgery index, Ergonomic parameters, Post-harvest operations, Power-operated machinery

AGRICULTURE, India's primary sector, employs a large female workforce, particularly in unorganised settings where women undertake labour-intensive tasks like sowing, weeding, harvesting, and post-harvest processing. Women contribute to 70% of major farm work and comprise 60% of the farming population (NSWF 2014), often working 12–13 h daily, including household chores. Millets, a key crop in semi-arid regions, are rich in nutrients and serve as food, fodder, and industrial input. Millets cultivation demands intensive labour, especially during post-harvest stages such as threshing and winnowing, where women face high physical and mental drudgery due to repetitive and challenging work. Drudgery is defined as the physical and psychological strain experienced during these tasks. The study aimed to assess women's discomfort through drudgery parameters and evaluate the

impact of improved technologies especially power-operated tools on reducing this burden. Emphasising ergonomics in equipment design and use can enhance efficiency, health, and quality of life for women farmers. Despite millets nutritional value, their consumption has declined due to labour-intensive manual processing and the easy availability of rice and wheat via the Public Distribution System (PDS). Traditionally, women performed post-harvest operations threshing, drying, winnowing, flour and flatbread making manually, leading to high physical drudgery. This study explored how improved, power-operated technologies (thresher, dryer, winnower, flour mill, and flatbread maker) can reduce women labour, time duration and discomfort in millet post-harvest operations. Based on women participation in millet farming under project trials, the

interventions were tested for their efficiency in reducing workload, improving posture, and minimising workdays.

A survey was conducted to assess drudgery among women in millet post-harvest operations and the impact of improved practices with 32 women (16 each from Chalki and Gangapur villages in Sangareddy district, Telangana) beneficiaries of the Farmers FIRST Project where millets were widely cultivated. It focused on five high-drudgery post-harvest operations: Threshing, drying, winnowing, flour making, and flatbread (*chapatti*) making, using eight power-operated technologies across nine millet crops. These operations were ergonomically evaluated to measure physiological cost and drudgery reduction. Ergonomic data were collected using a weighing machine and measuring tape. Descriptive statistics (mean, frequency,

percentage) were used to analyse data.

Time spent on post-harvest operations

The data showed the highest time was spent on traditional winnowing (6.91 h/day) and threshing (6.72 h/day). With power-operated tools, threshing time reduced to 3.01 h/day (55% less) and winnowing to 3 h/day (57% less). Sun drying required 6 h/day, whereas hot dryers cut this by 59% (2.48 h/day). Manual flour making took 3 h/day, reduced by 90% (0.31 h/day) using a flour mill. Likewise, flatbread preparation dropped from 2.95 to 2.04 h/day (31% reduction). Grinding 1 kg of finger millet, which took two woman-hours, was completed in 10 min with machinery. Overall, improved practices saved 31–90% of time, significantly easing women's workload. Time reduced substantially in performing post-harvest operations of millets using improved practice compared to traditional practice.

Table 1. Time Spent on Post-Harvest Operations under traditional practice (TP) and improved practice (IP)

Operation	TP (h/day)	IP (h/day)
Threshing	6.72	3.01
Drying	6.00	2.48
Winnowing	6.91	3.00
Making flour	3.00	0.31
Flatbread making	2.95	2.04

Survey conducted by ICAR-IIMR during project period.

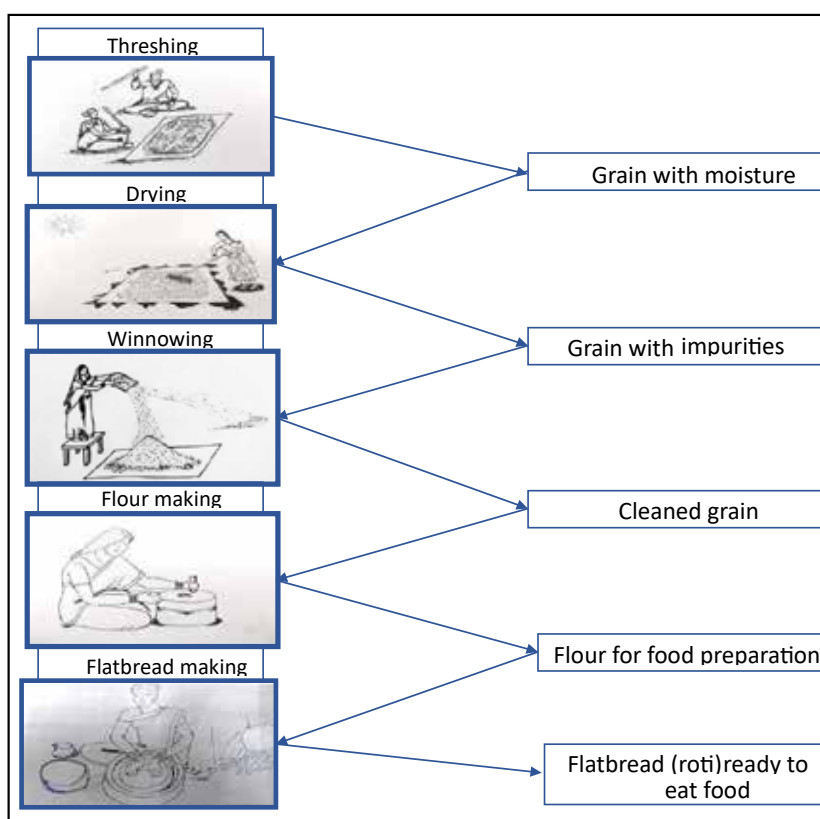
Difficulty of operation

Pain, as an indicator of physical discomfort, was measured using a five-point scale ranging from 'most difficult' to 'very easy'. Results showed that a majority of women (68.7%) found threshing with traditional methods to be the most difficult task, while none reported it as such when using a power-operated thresher; instead, 59.3% rated it as neutral. For drying, 65.6% perceived traditional sun drying as very difficult, whereas all respondents (100%) found the mechanical dryer easy to use. In manual winnowing, 56.2% reported high discomfort, while 59.3% rated the power-operated winnower as

Table 2. Difficulty felt in performance of the post-harvest operations by the respondents

Categories		*Operation performed				
		Threshing	Drying	Winnowing	Making flour	Chapatti making
Very easy	TP	-	-	-	-	-
	IP	-	-	-	32 (100)	-
Easy	TP	-	-	-	-	-
	IP	9 (28.1)	32 (100)	9 (28.1)	-	16 (50.0)
Neutral	TP	2 (6.2)	-	-	-	-
	IP	19 (59.3)	-	19 (59.3)	-	16 (50.0)
Difficult	TP	8 (25.0)	11 (34.3)	14 (43.7)	-	-
	IP	4 (12.5)	-	3 (9.3)	-	-
Most difficult	TP	22 (68.7)	21 (65.6)	18 (56.2)	32 (100)	32 (100)
	IP	-	-	1 (3.1)	-	-

Percentage are mentioned in parentheses. TP, Traditional practice; IP, Improved practice. Survey conducted by ICAR-IIMR during project period; *Multiple responses.

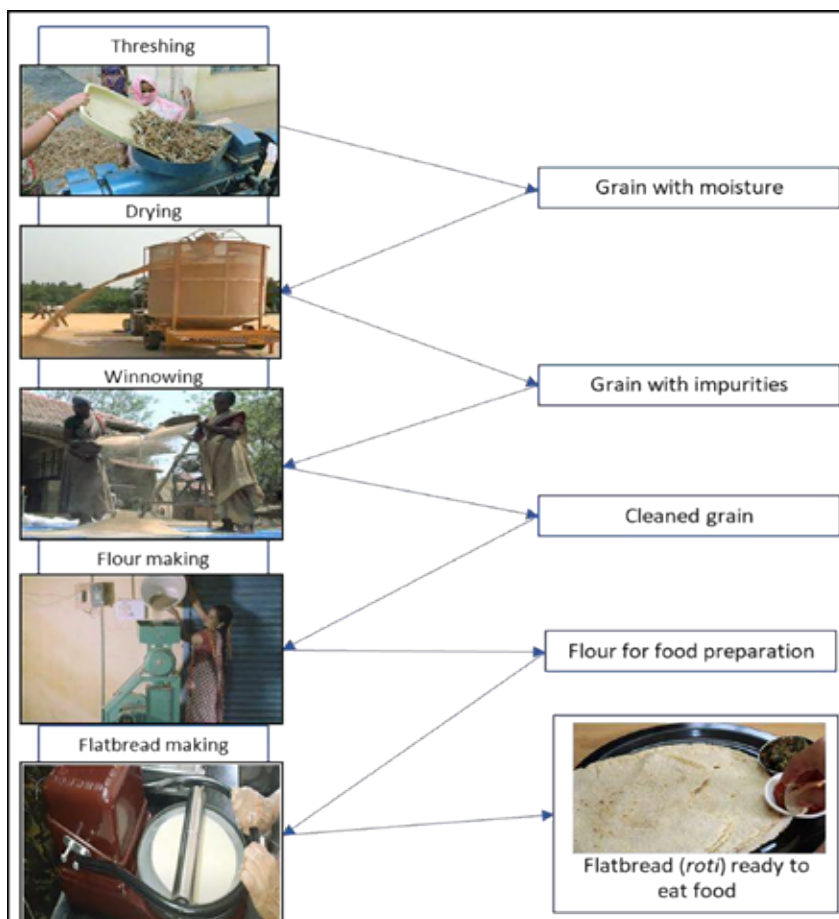


Schematic diagram of post-harvest operations of millets performed by women with traditional practices

very easy. All participants found traditional flour making very difficult, but considered it very easy when using a flour mill. Similarly, all women reported flatbread making by hand as the most difficult and time-consuming task; however, 100% found it very easy with the power-operated roti maker. Overall, the use of improved technologies significantly reduced discomfort and effort across all post-harvest activities.

Drudgery index

The Drudgery Index measures the level of physical strain, time consumption, fatigue, and discomfort experienced by farmers while performing agricultural operations. In the post-harvest practices of millets, the drudgery index is generally high, especially among small and marginal farmers, due to the labour-intensive and manual nature of operations and was measured using a Drudgery



Schematic diagram of post-harvest operations of millets performed by women with improved practices



Scientists visit to the selected villages to observe post-harvest operations

SUMMARY

The study highlights that threshing and winnowing are the most physically demanding post-harvest operations in millet cultivation when performed using traditional methods, exposing women to dust inhalation, repetitive strain, and risk of injury. Adoption of improved, power-operated machinery not only reduced drudgery and time but also minimised health hazards, enhanced work efficiency, and improved the overall quality of life of women farmers. Reduced workload enabled women to allocate time to income-generating activities and household responsibilities, thereby contributing to economic empowerment and livelihood security. The findings of the study underscore the critical importance of mechanization and ergonomic interventions in millet post-harvest systems. The significant reduction in drudgery, time, and physical discomfort achieved through improved technologies demonstrates their effectiveness in addressing gender-specific labour challenges in agriculture. Promotion and adoption of suitable, women-friendly post-harvest machinery for millets are strongly recommended to enhance productivity, improve health outcomes, and support sustainable rural development. The study provides valuable empirical evidence to guide policymakers, researchers, and development agencies in designing gender-sensitive interventions for millet-based farming systems.

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Index (DI), which is based on time, frequency, and difficulty coefficients. A high drudgery index in millet post-harvest operations results in lower productivity, increased health risks, and reduced adoption of millet cultivation. Introduction of improved post-harvest tools, small-scale mechanisation, ergonomic equipment, and capacity building can substantially reduce drudgery, save time, and improve farmers' well-being and income. DI scores were categorised as: maximum drudgery (≥ 70), moderate (50–69.9),

and minimum (< 50). Traditional methods showed maximum drudgery in chapatti making (DI=78.97), followed by winnowing (72.52), threshing (72.16), flour making with pounding (70.41), and drying (70.28). Daily flatbread preparation contributed to its highest score. In contrast, improved practices using power-operated machines reduced drudgery across all tasks flatbread making dropped to moderate (DI=58.51), while others fell into the minimum drudgery category.

Table 3. Drudgery index for the selected post-harvest operations of improved practices over traditional practices

Operation	DI (IP)*	Remarks	DI (TP)*	Remarks
Threshing	4.84	Minimum	72.16	Maximum
Drying	37.01	Minimum	69.40	Moderate
Winnowing	45.00	Minimum	72.52	Maximum
Making flour	38.16	Minimum	70.41	Maximum
Flatbread (<i>chapati</i>) making	58.51	Moderate	78.97	Maximum

DI, Drudgery index; TP, Traditional practice; IP, Improved practice.

Survey conducted by ICAR-IIMR during project period; *Multiple responses.