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Feminine farm operational methods, involvement, hardships and sensitivity in farming systems analysis

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ABSTRACT

The present study has been conducted to identify the sensitivity in the pre-dominant farming systems of Western plain zone of Uttar Pradesh (WPZ) considering the importance of gender specific technologies much needed for better efficiency and productivity of farming systems. Four pre-dominant farming systems have been identified in WPZ of Uttar Pradesh with the highest area share (57.1%) and highest farmer distribution (62.9%) in FS_1: Crop + Dairy (1C+1-2B). The highest net return was found in FS_2: Crop + Horticulture (Fruits) + Dairy (2C+ 1-2 B), whereas the lowest net return was noticed in FS_3: Crop + Horticulture (Vegetables) + Dairy (1C + 1B). Load carrying through head load was found extensively performed by the women of FS_3 followed by FS_4: Horticulture + Crop + Dairy (1C+1B) and FS_2 respectively. Chopper (hand tool) for chaff cutting, winnowing through natural wind, power operated winnowing without safety gadgets was performed in FS_4 (33%), FS_3 (22.8%) and FS_4 (17%) respectively by family female workers. Threshing through hand beating was maximally performed by FS_2 (81%) as hired female labour. Work involvement in farming system studies shows that female workers (family and hired) of FS_3 contributed maximum (44.7%) followed by FS_1 (41.5%). Also, the women participation index on drudgery prone activities was found highest amongst female workers (family and hired) of FS_3 (87.8%) followed by FS_1 (83.21%). The results indicate that FS_3 may be tagged as sensitive farming system with respect to maximum number of female headed households contributing maximum work and hardships followed by FS_1.

Key words: Farming Systems, Farm operations, Feminine, Pre-dominant, Women participation index

In India, around 78% of the economically productive women in the country are engaged in various activities related to agricultural and allied enterprises as compared to 63% of men. The ratio of agricultural workers to the total workers is expected to decline to 40% from 52% by 2020, though the total number would remain the same. Agriculture ranks one of the hazardous industries as it has potentially much harmful ergonomic/health impact causing immense pain and hardships (Kumar *et al.* 2018). Use of traditional tools for long hours with inappropriate working posture in field leads to drudgery (Singh 2014). Therefore, attention needs to be given to their capabilities and limitations during design and operation of various farm equipment's, to get higher productivity, enhanced comfort and ensure better safety (Yadav *et al.* 2010). Irrespective to this, their access to productive resources (such as land and livestock), inputs (fertilizers and improved seeds), and services (credit, extension) for agriculture reflects a "gender gap" that most often is rooted in social norms specific to a given geography and culture (FAO 2011). Despite their substantial role in agronomic activities women are not addressed by agricultural research and extension services that lead to reduced effectiveness in enhancing food security or improving rural livelihoods (World Bank, FAO, IFAD 2009, Galie *et al.* 2013). Gender sensitivity in farming systems research and development are considered to be crucial for effectively contributing to gender equity, improving the effectiveness of agricultural interventions in terms of poverty alleviation and improvement of household nutrition. Very little research has systematically examined the connection between farming systems and the status of women, that is, their level of empowerment relative to men, specifically in the domain of agriculture (Gupta *et al.* 2017).

Therefore, the study was carried out to identify the sensitivity through feminine farm operational methods, work related involvement, hardships and hazards in the explored farming systems of Western plain zone of Uttar Pradesh.

MATERIALS AND METHODS

The study area encompasses the pre-dominant farming systems of Western plain zone of Uttar Pradesh, India which is located at (N 28° 98′ E 77^0 07′) Meerut, (N 28° 23′, E

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77º 50′) Bulandshahar, (N 29º 34′ & 30º 21′, E 77º 9′ & 78º 14′) and Saharanpur districts, in which a survey was conducted in 2015–16 and 2016–17. It is characterized by average altitudes ranging from 195 to 268 m amsl. The Zone covering a total of 1637424 ha geographical area, predominated with irrigated agriculture. The total sample comprises a random sample of 180 households (i.e. 3 Districts × 3 blocks/district × 2 villages/ block × 10 households) using a stratified sampling frame. Quantitative data was collected by personal interview method using pre-tested structured questionnaire with men and women farmers. The responses were tabulated and data were analysed using descriptive statistical tools, viz. frequency, percentage, mean, standard error and range. Feminine farm operations was measured by the binary response (1= Female contributed, 0 otherwise). Qualitative data was collected with sex disaggregated focussed farmer group discussions (men and women). Perceptions and observations of gender were recorded for analysis of qualitative data and theories built from these observations.

Drudgery score: Drudgery score has been calculated on the basis of: X = coefficient pertaining to difficulty felt, Y= coefficient pertaining to time spent in particular activity, Z= coefficient pertaining to difficulty of performance.

$$\text{Drudgery score} = [X+Y+Z/3] \times 100$$

Percentage of Women Participation Index: A percentage of women participation index was calculated to determine the participation rate of women in drudgery prone farming system activity. This was based on the following formula:

Percentage of Women Participation Index (WPI) = (Actual participation of women/Full participation) × 100 for each activity

RESULTS AND DISCUSSION

The salient findings regarding identification of sensitivity through feminine farm operational methods, work involvement and hardships in the explored pre-dominant farming systems are presented as follows.

Socio-economic profile: Around 95% households were found under the male headship and reaming was found under the female headship. All the households were doing farming in FS_2, whereas in FS_3, 25% households were working as labourers along with farming. The average landholding was found 2.75 ha per farm household under men ownership and 0.19 ha per farm household under women ownership. Amongst them FS_2 was having maximum farm size, i.e. 6.85 ha per farm household under men ownership and 0.48 ha per farm household under women ownership. FS_4 exhibiting the least farm size as 1.07 ha per farm household under men ownership and nil area under women ownership.

Pre-dominant farming systems: The analysed data revealed that around 62.9% of households were having FS_1 covering 57% total farming area with annual net return of ₹ 1,24730 and was a dominant farming system in WPZ of Uttar Pradesh. The highest net return of ₹ 315420 was found in FS_2, whereas the lowest net return of ₹ 117190 was noticed in FS_3. Sugarcane/sorghum-ratoon-wheat found to be the most dominant cropping system followed by paddy-wheat in WPZ of Uttar Pradesh. The major crops sown in all the pre-dominant farming system was wheat followed by sugarcane covering more than 60% of gross sown area, whereas in case of FS_2 sugarcane followed by mango were found the major crops sown, covering more than 2/3rd of gross sown area.

Feminine farm operations: Work involvement

Maximum female contribution was found in FS_3 followed by FS_1. For various farm operations, viz. collection, carrying of dung as headload, milking, weeding, harvesting in field crops, stripping of groundnut, seed treatment using local and chemical materials, winnowing under fan, the female contribution as family labour was found highest (53–100%) in FS_1, however, paddy transplanting was found highly contributed by hired female labours (62%). On the contrary, the least female contribution as family labour was observed in FS_2, however through hired labour it was found maximum for various farm operations, viz. carrying of fodder as headload, manual placing of seeds in soil, paddy transplanting, weeding and harvesting of field crops, threshing through hand beating, bundling of cane (50–81%). Collection and carrying of fodder as headload, paddy transplanting and threshing through hand beating are main activities that have been exclusively carried out by hired female workers. This is due to the highest farm size under both the male and female ownership as well as highest net returns under FS_2.

In case of FS_3 female contribution as family labour was found highest in maximum no. of farm operations, viz. carrying of fodder as headload, collection, carrying of dung as headload, milking, fodder chaffing through electricity/ diesel engine, vegetable transplanting, hoeing and weeding in vegetables and field crops, harvesting in field crops, seed treatment using local material winnowing under fan (50–100%). However, paddy transplanting and threshing through hand beating were found highly contributed by hired female labours (76 and 55%) respectively. This may be due to the multiple enterprises and highest households under female headship. Singh *et al.* (2009) also reported that vegetable based farming system provides maximum employment. Similarly in FS_4 female contribution as family labour was highest in various farm operations, viz. collection, carrying of dung as headload, milking, fodder chopping through manually operated chaff cutter, manually placing of seeds in soil, weeding in field and vegetable crops, harvesting of field crops, seed treatment using local material (50–100%). However, paddy transplanting was contributed by 50% of hired female labours. The overall contribution of females as hired labourers was only 4.1%. This may be due to the least farm size (1.07 ha per farm household) with nil land under female farmers. Similar findings were reported by Kumar *et al.* (2018) in case of animal dung collection and disposal, milking, storage, threshing, winnowing, harvesting, weeding, paddy transplanting etc. (Table 1).

Table 1 Feminine farm operational methods and work involvement

Farm operation	Work involvement							
	$FS_{1\ (n=113)}$		$FS_{2\ (n=17)}$		$FS_{3\ (n=34)}$		$FS_{4\ (n=12)}$	
	FL	HL	FL	HL	FL	HL	FL	HL
Collection and carrying of wood for fuel								
As headload	0.26	0.08	0.20	0.15	0.48	0.00	0.25	0.00
As cart	0.17	0.00	0.05	0.00	0.15	0.00	0.00	0.00
Carrying of fodder								
As headload	0.28	0.13	0.07	0.56	0.32	0.17	0.38	0.00
As cart	0.38	0.00	0.36	0.00	0.52	0.00	0.29	0.00
Collection of dung	0.94	0.00	0.70	0.00	1.00	0.00	1.00	0.00
Milking	0.95	0.00	0.78	0.00	1.00	0.00	0.92	0.00
Carrying of dung as headload	0.81	0.00	0.37	0.00	0.88	0.00	0.83	0.00
Fodder chaffing								
Electricity/diesel engine operated	0.46	0.00	0.31	0.00	0.52	0.00	0.16	0.00
Manually operated	0.32	0.00	0.12	0.00	0.28	0.00	0.50	0.00
Chopper	0.08	0.00	0.00	0.00	0.029	0.00	0.33	0.00
Sowing								
Broadcasting	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manually placing of seeds in soil (Dibbling)	0.22	0.19	0.06	0.56	0.23	0.14	0.66	0.00
Sett planting								
Dropping canes manually	0.10	0.14	0.20	0.46	0.03	0.14	0.33	0.00
Paddy transplanting	0.23	0.62	0.00	0.81	0.06	0.76	0.16	0.50
Vegetable transplanting	0.00	0.00	0.00	0.00	0.87	0.00	0.22	0.07
Fertilizer application								
Broadcasting	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Under furrow	0.09	0.00	0.00	0.00	0.05	0.00	0.16	0.00
FYM preparation	0.25	0.03	0.00	0.00	0.08	0.00	0.17	0.00
Carrying of manure								
Cart	0.05	0.00	0.06	0.00	0.08	0.00	0.20	0.00
As headload	0.04	0.00	0.00	0.00	0.06	0.00	0.16	0.00
Furrow irrigation	0.33	0.00	0.00	0.00	0.23	0.00	0.33	0.00
Weeding in field crops	0.53	0.38	0.27	0.73	0.66	0.29	0.66	0.18
Hoeing and weeding in vegetables	0.00	0.00	0.062	0.062	0.57	0.14	0.76	0.076
Earthing up in potato	0.00	0.00	0.00	0.00	0.32	0.49	0.16	0.00
De-trashing and de-topping in sugarcane	0.32	0.18	0.25	0.25	0.23	0.30	0.25	0.08
Cane cutting	0.25	0.08	0.18	0.00	0.23	0.029	0.08	0.08
Bundelling of cane	0.31	0.16	0.25	0.50	0.29	0.009	0.08	0.08
Harvesting of field crops	0.55	0.37	0.19	0.68	0.82	0.12	0.83	0.08
Paddy Threshing								
Hand beating	0.32	0.37	0.00	0.81	0.14	0.55	0.16	0.33
Dehusking of maize	0.17	0.16	0.00	0.18	0.29	0.058	0.0	0.00
Stripping of groundnut	0.96	0.08	0.125	0.125	0.00	0.00	0.00	0.00
Seed treatment for storage using chemical	0.64	0.00	0.31	0.00	0.41	0.00	0.33	0.00

Cond.

Table 1 (*Concluded*)

Farm operation	Work involvement							
	$FS_{1\ (n=113)}$		$FS_{2\ (n=17)}$		$FS_{3\ (n=34)}$		$FS_{4\ (n=12)}$	
	FL	HL	FL	HL	FL	HL	FL	HL
Seed treatment for storage using local materials	1.00	0.0	1.00	0.00	1.00	0.00	0.83	0.00
Winnowing								
Power operated	0.05	0.00	0.00	0.00	0.05	0.00	0.17	0.00
Under Fan	0.73	0.00	0.74	0.00	0.85	0.00	0.32	0.00
Natural wind	0.165	0.00	0.00	0.00	0.228	0.00	0.00	0.00
Total Mean ± SE	0.333± 0.304	0.082± 00.144	0.184± 0.025	0.163± 0.271	0.359± 0.327	0.088± 0.178	0.324± 0.29	0.041± 0.102
Range	0-1.0	0-0.62	0-1.0	0-0.81	0-1.0	0-0.76	0-1.0	0-0.50

FS_1, Crop + Dairy (1C+1-2B); FS_2, Crop + Horticulture (Fruits) + Dairy (2C+ 1-2 B); FS_3, Crop + Horticulture (Vegetables) + Dairy (1C + 1B); FS_4, Horticulture + Crop + Dairy (1C+1B). Each farm operation was measured by the binary response (Female contributed = 1, otherwise 0) FL = Family labour, HL = Hired labour

Feminine farm operations: Ways and means

Ways and means of some female dominating farm operations, viz. load carrying, chaffing, threshing and winnowing have been explained. Load carrying through headload (15–25 kg) in case of dung and manure carrying (30–50 kg) in case of fuel wood and fodder carrying were found extensively performed by the women belongs to FS_3 followed by FS_4 working as family labour. However, headload carrying by hired labour was found maximum in FS_2 . Load carrying through cart was mainly performed by FS_3 followed by FS_1 (Fig 1a). Load carrying requires moderate to extremely heavy energy expenditure (Ramanathan and Nag 1982).

Chaff cutting activity was mainly performed by the women belongs to FS_4 followed by FS_3 working as family labour. Similarly, the most difficult procedure was used by FS_4 (33%) (chaff cutting through chopper, hand tool) (Fig 1b). Joshi *et al.* (2018) found a very strong exertion and high postural risk factor during the fodder cutting activity through chopper amongst hill women farmers. Manually operated chaff cutter is physically demanding through its moderately heavy energy requirements and postural ailments commonly regarded as source of drudgery (Nag and Nag 2004, Badiger *et al.* 2004). In spite of this, 11% of non-fatal injuries in northern India was reported while working with manual and electricity operated chaff cutters amongst the total injuries due to lack of adhering safety gadgets to the machinery. However, the hand tools related accidents accounted for 8% of the total accidents (Nag and Nag 2004).

Paddy threshing through hand beating and winnowing was found to be performed maximum by both FS_1 and FS_3 as family labour. Winnowing under fan was the foremost method for the women farmers in all the farming systems, maximum being practised by FS_3 followed by FS_2, FS_1

Table 2 Women's participation index on drudgery prone activities

Feminine farm operations			$FS_{1\ (n=113)}$		$FS_{2\ (n=17)}$		$FS_{3\ (n=34)}$		$FS_{4\ (n=12)}$	
Drudgery prone activities			Women Participation Index (%)							
		Drudgery Score	FL	HL	FL	HL	FL	HL	FL	HL
Carrying of dung	Headload	62.580	94.00	0.00	64.91	0.0	100.00	0.0	100.00	0.00
Collection and carrying of fodder	Headload	61.700	66.63	29.54	10.76	86.15	65.30	39.69	92.60	0.00
Cane cutting	Balkati/Kasola	60.800	35.71	11.42	24.32	0.00	45.16	0.0	33.00	0.00
De-trashing and de-topping	Using traditional knife	60.760	44.44	25.00	33.70	33.70	35.93	46.97	50.00	16.60
Harvesting of field crops	Using serrated sickle	60.000	55.00	37.00	19.00	68.00	82.00	12.00	83.00	8.00
Paddy transplanting	Manual	56.660	27.70	72.90	0.00	100.00	07.31	92.68	24.24	75.75
Total mean ± SE		60.41 ± 0.83	53.91± 9.79	29.31± 10.25	25.44± 9.18	47.97± 17.6	55.95± 13.6	31.89± 14.6	63.80± 13.18	16.72± 12.10

and FS_4 (85–32%). Winnowing through age old traditional method (natural wind) was performed maximum in FS_3 as family labour (22.8%). Winnowing through power operated winnower without safety gadgets wearing improper clothing was maximum being practiced by FS_4 (17%) followed by FS_1 and FS_3. However, threshing through hand beating was maximally performed by FS_2 (81%) as hired labour (Fig 1c). Winnowing under fan and natural wind requires light to moderate energy expenditure, whereas paddy threshing through beating requires moderate to extremely heavy expenditure (Khadatkar *et al* 2018). Around 14.6% incidents were observed while using power operated threshers/ winnowers due to lack of safety gadgets (Nag and Nag 2004).

Women's drudgery and Work Participation Index: Carrying of dung as headload and fodder collection and carrying are the most drudgery prone activities depicted by their drudgery scores (62.580 and 61.700) respectively. Cane cutting, de-trashing and de-topping of sugarcane and harvesting of field crops followed by paddy transplanting found to be the next drudgery prone activities in the pre-dominant farming systems of WPZ of Uttar Pradesh. The results have been supported from the study done by Verma *et al.* (2017) who also revealed that the maximum time spent by women farmers in fodder collection, dung collection, carrying of dung as headload, detrashing and detopping of sugarcane in the pre-dominant farming systems of WPZ of Uttar Pradesh.

The overall women participation index on drudgery prone activities was found highest in the female workers (family and hired) of FS_3 (87.8%) followed by FS_1 (83.21%). This may be due to the multiple enterprises under FS_3, more animals per household reared by female family workers in FS_1. However, amongst family female workers it was found highest in FS_4 (63.8%). This may be due to reason of least farm size (1.07/ha household) under male ownership as well as nil farm size under female ownership remains the family female workers as invisible. Contrarily, amongst hired female workers highest WPI on drudgery prone activities was found in FS_2 (47.97%). This is due to the highest farm size under both the male and female ownership (6.60 and 0.45/ha household) respectively (Table 2).

The study revealed that FS_2 is receiving highest net returns whereas, FS_3 receiving lowest. The highest farm size was found in FS_2 under female ownership and nil ownership

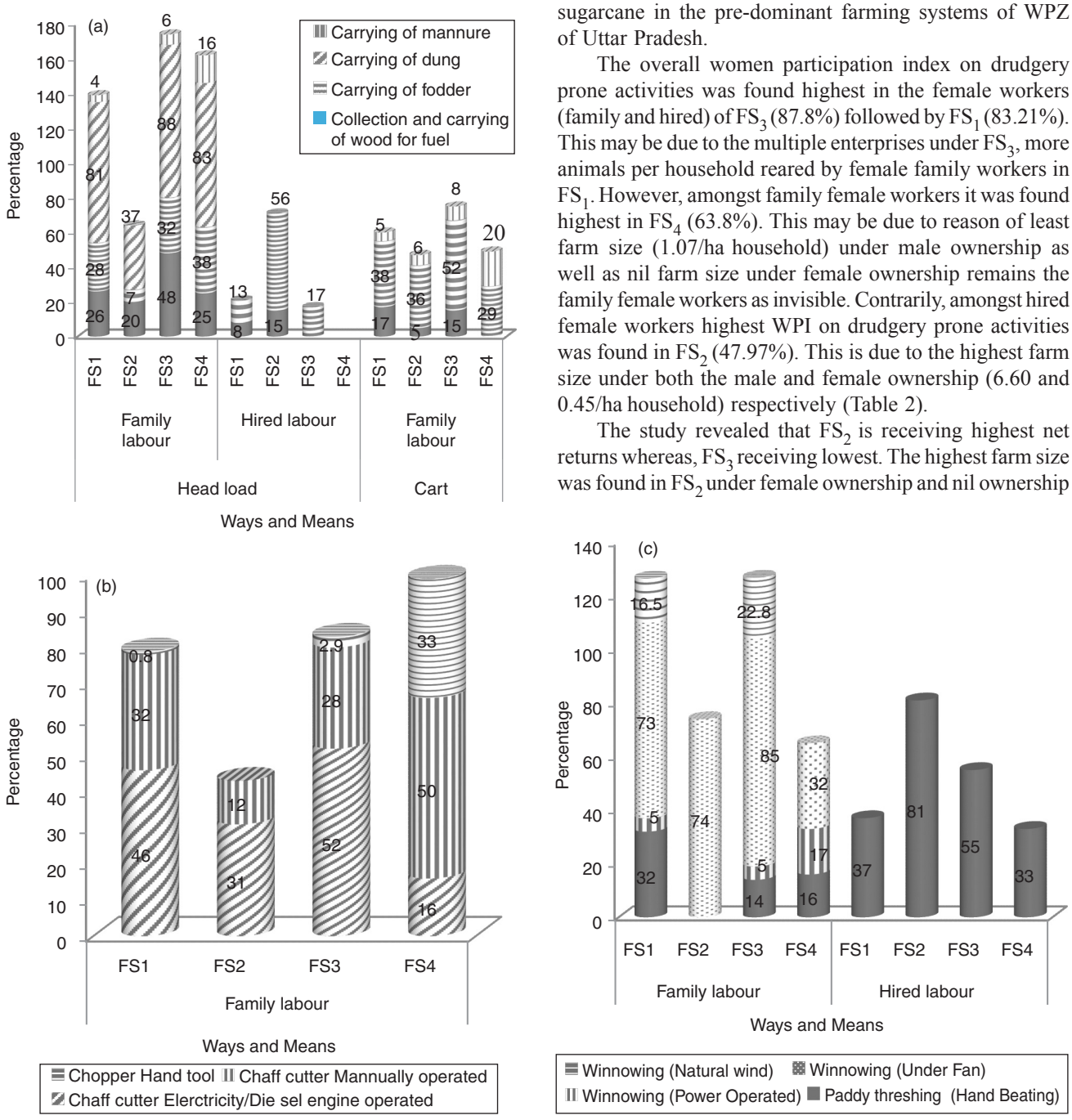

Fig 1 (a) Load carrying activity, (b) Chaff cutting activity, (c) Threshing and winnowing activity.

of farm land for female farmers were noticed under FS_4. Work involvement in farming system studies shows that female workers (family and hired) of FS_3 contributed maximum followed by FS_1. Load carrying through headload was found extensively performed by the women belongs to FS_3 followed by FS_4 working as family labour. As hired labour, maximum headload carrying was found in FS_2. Chaff cutting, through chopper (hand tool), winnowing through natural wind, power operated winnowing without safety gadgets was performed in FS_4 (33%), FS_3 (22.8%) and FS_4 (17%) respectively by family female workers. Threshing through hand beating was maximally performed by FS_2 (81%) as hired female labour. The WPI on drudgery prone activities was found highest in the female workers (family and hired) of FS_3 (87.8%) followed by FS_1 (83.21%). The results indicate that FS_3 may be tagged as sensitive farming system with respect to maximum number of female headed households contributing maximum work and hardships followed by FS_1. In terms of work hardships the sensitivity was found highest in FS_4 and FS_2 as family and hired female workers respectively.

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