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 FS₁: Crop + Dairy (1C+1-2B). The highest net return was found in FS₂: Crop + Horticulture (Fruits) + Dairy (2C+ 1-2 B), whereas the lowest net return was noticed in FS₃: Crop + Horticulture (Vegetables) + Dairy (1C + 1B). Load carrying through head load was found extensively performed by the women of FS₃ followed by FS₄: Horticulture + Crop + Dairy (1C+1B) and FS₂ respectively. Chopper (hand tool) for chaff cutting, winnowing through natural wind, power operated winnowing without safety gadgets was performed in FS₄ (33%), FS₃ (22.8%) and FS₂ (17%) respectively by family female workers. Threshing through hand beating was maximally performed by FS₂ (81%) as hired female labour. Work involvement in farming system studies shows that female workers (family and hired) of FS₃ contributed maximum (44.7%) followed by FS₁ (41.5%). Also, the women participation index on drudgery prone activities was found highest amongst female workers (family and hired) of FS₃ (87.8%) followed by FS₁ (83.21%). The results indicate that FS₃ may be tagged as sensitive farming system with respect to maximum number of female headed households contributing maximum work and hardships followed by FS₁.

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° 07’) Meerut, (N 28° 23’, E
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77° 50'); Bulandshahar, (N 29° 34' & 30° 21'; E 77° 9' & 78° 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 farming 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.

Drudgery score=[X+Y+Z/3] × 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 FS3, whereas in FS1, 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 FS2 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. FS4 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 FS1 covering 57% total farming area with annual net return of ₹ 1,24730 and was a dominating farming system in WPZ of Uttar Pradesh. The highest net return of ₹ 315420 was found in FS2, whereas the lowest net return of ₹ 117190 was noticed in FS4. 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 FS2 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 FS3 followed by FS1. 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 FS1, 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 FS2, 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 FS2.

In case of FS1 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 chopping 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 FS1 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 |
|----------------------------------------|------------------|
|                                        | FS1 (n=113) | FS2 (n=17) | FS3 (n=34) | FS4 (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 |
| Sowing of manure                        |       |       |       |       |       |       |       |       |
| 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 |
| Application of manure                  |       |       |       |       |       |       |       |       |
| 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 |
| Harvesting of field crops              |       |       |       |       |       |       |       |       |
| 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       | 0.64  | 0.00 | 0.31 | 0.00 | 0.41 | 0.00 | 0.33 | 0.00 |

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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\(^1\).

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\(^4\) followed by FS\(^3\) working as family labour. However, headload carrying by hired labour was found maximum in FS\(^4\). Load carrying through cart was mainly performed by FS\(^4\) 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).

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### 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   | FL   | HL   |
| Seed treatment for storage using local materials       | 1.00 | 0.0  | 1.00 | 0.0  | 1.00 | 0.0  | 0.83 | 0.0  |
| Winnowing                                             |                  |                  |                  |                  |                  |      |      |      |      |
| Power operated                                         | 0.05 | 0.0  | 0.00 | 0.0  | 0.05 | 0.0  | 0.17 | 0.0  |
| Under Fan                                             | 0.73 | 0.0  | 0.74 | 0.0  | 0.85 | 0.0  | 0.32 | 0.0  |
| Natural wind                                           | 0.165| 0.00 | 0.00 | 0.00 | 0.228| 0.00 | 0.00 | 0.00 |
| Total Mean ± SE                                        | 0.333±| 0.082±| 0.184±| 0.163±| 0.359±| 0.088±| 0.324±| 0.041±|
| Range                                                  | 0.1-0.62| 0-1.0| 0.025| 0.271| 0.327| 0.178| 0.29 | 0.102|

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\(^4\) followed by FS\(^3\) working as family labour. However, headload carrying by hired labour was found maximum in FS\(^4\). Load carrying through cart was mainly performed by FS\(^4\) followed by FS\(^1\) (Fig 1a). Load carrying requires moderate to extremely heavy energy expenditure (Ramanathan and Nag 1982).

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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                    | Drudgery Score  | FL  | HL  | FL  | HL  | FL  | HL  | FL  | HL  |
| Carrying of dung (Headload)                  | 62.580          | 94.00 | 0.00 | 64.91 | 0.00 | 100.00 | 0.00 | 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 | 0.00 | 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±         | 53.91± | 29.31± | 25.44± | 47.97± | 55.95± | 31.89± | 63.80± | 16.72± |
| Range                                        | 0.83           | 9.79  | 10.25 | 9.18  | 17.60 | 13.60 | 14.60 | 13.18 | 12.10 |
and FS4 (85–32%). Winnowing through age old traditional method (natural wind) was performed maximum in FS3 as family labour (22.8%). Winnowing through power operated winnower without safety gadgets wearing improper clothing was maximum being practiced by FS4 (17%) followed by FS1 and FS2. However, threshing through hand beating was maximally performed by FS3 (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 thresher/winnower due to lack of safety gadgets (Nag and Nag 2004).

**Women’s drudgery and Work Participation Index:**

Winnowing through age old traditional method (natural wind) was performed maximum in FS3 as family labour (22.8%). Winnowing through power operated winnower without safety gadgets wearing improper clothing was maximum being practiced by FS4 (17%) followed by FS1 and FS2. However, threshing through hand beating was maximally performed by FS3 (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 thresher/winnower due to lack of safety gadgets (Nag and Nag 2004).

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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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