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Impact of Reduced drudgery of women in production and post-harvest processing of small millets

Gender Mainstreaming and Institutionalization (GIM) group
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Abstract

Historically, women play a crucial role in the on-farm production and processing of millets. At the small and marginal farm holdings and households, women's drudgery in production and post-harvest processing is one of the reasons for the neglect of millets cultivation. Besides, lower profitability of millets compared to alternative crops, the demand of women labour for agronomic practices especially weeding and harvesting, drudgery in pounding and lack of processing machines especially for littlemillet and italianmillet species are the other reasons for neglecting them in farming as well as its use as food. In Kolli Hills, apart from maintenance of interaspecific millet diversity, the communities also evolved different cropping systems appropriate for these millets. The small millet grains, unlike the principal cereal grains, have superior nutritional profile for more than one dietary component. So in order to revive the growing of millets, the M. S. Swaminathan Research Foundation have been facilitating development programmes to ease women's work burden. This research seeks answers to "what extent simplified farm implements and post harvest technologies reduced the drudgery of women in on farm and off farm activities in millets"? The paper explains about the millet-specific production and post-harvesting constraints faced by women and the effect of use of farm implements and machineries in reducing drudgery and saving time for women in the millet production systems.

Introduction

Agrobiodiversity includes all components of biological diversity of relevance to food and agriculture and plays a vital role in food and nutritional security of people (Thrupp, 1998). The strategic role of agrobiodiversity in strengthening the livelihood of local communities in tribal and rural areas and also the equity and ethics in the utilization of such agrobiodiversity have been highly emphasized (Swaminathan, 1996, Jarvis and Hodgkin, 2008). In recent decades, agro-biodiversity and associated cultural diversity have been undergoing increasing erosion due to selective utilization of a narrow genetic base. Such reduced deployment of

agrobiodiversity is causing poor nutritional security among people (Bala Ravi *et al*. 2006). This is further aggravated by the increased dependence on a few high yielding varieties of a handful of selected crops.

The decreasing importance to the ecological functions of biodiversity, increasing shift to mono-cropping system, near exclusive focus on cash crops in agri-business and value chains are major factors aggravating the neglect of a large number of diverse crops, which had been serving as important livelihood options for local communities, particularly those living in poor and marginalized conditions. Many of these neglected crops are embedded in ecological niches where the commodity crops do not offer a commercial edge. These niches are defined invariably by low and erratic rainfall, poor soils, and marginalized crop management practices, semi-arid, hilly or mountainous agro-geographical conditions of tropics and subtropics and high-risk associated crop productivity. In the Indian context, a wide range of millets species are neglected and face challenges from the stage of seeds to markets (MSSRF 2002, King et al 2013, 2014, 2015a, 2015b) and these nutritive and climate resilient crops are increasingly being neglected by both men and women. Historically, women play a crucial role in the off-farm production and processing of millets. Much of the work related to on-farm and post-harvest processing for use is laborious, time consuming and involves drudgery. These were some of the reasons why millet was being given up in favour of male-preferred cash crops.

So in order to revive the growing of millets, the M.S.Swaminathan Research Foundation (MSSRF) decided to ease women's work burden. MSSRF had designed a Participatory Research to address on-farm and post-harvest processing in millets at Kolli Hills in Tamil Nadu with the support of International Fund for Agricultural Development (IFAD) and International Development Research Centre (IDRC). This research seeks answers to "what extent simplified farm implements and post harvest technologies reduce drudgery of women in on farm and off farm activities in millets"? This participatory research was conducted during the period of Kharif (summer crops) in 2011 to 2014 with the involvement of Agrarian tribal inhabitants in Eastern Ghats. The paper explains about the millet-specific production and post-harvesting constraints faced by women and the effect of use of farm implements and machineries in reducing drudgery of women and to save time in the millet production systems.

Research Context: Kolli Hills and Millet Ecosystems

Kolli Hills, spreading across an area of 441 km^2, is located in the eastern part of Namakkal district in Tamil Nadu in Southern India. The region constitutes the southern tip of the Eastern Ghats. The altitude of the hills ranges from 180 to 1,415 m above MSL. The local hill dwelling community is believed to have migrated to these Hills from the Northern plains of Tamil Nadu about three to four centuries ago (Thurston 1909, Vedavalli *et al*. 2002). During those days, the Kolli Hills were totally cut off from the adjoining plains with no roads. Hence, the community used to heavily depend on minor millets (Annexure 1), which were grown under rainfed conditions, to meet their food needs. Among the five minor millets mentioned, finger millet, little millet and Italian millet were grown predominantly, in that order. Under continuous cultivation during three to four centuries, the community has evolved several land races of these millets, which are suited to different agro-ecological conditions prevalent in different hill formations of this region. Such genetic diversity in nutritional millets at species and genetic levels had been playing strategic role in providing food and nutritional security to the people living in fragile agro-ecological situations. Apart from this rich genetic diversity, the communities also evolved different cropping systems appropriate for these millets. Such cropping systems having crops with varied food and commercial value combine the advantage of crop duration under erratic rainfall (varying from 90 to 180 days), rooting pattern to extract soil moisture from different depths, canopy complementation to enhance unit productivity, minimizing risks and meeting diverse household needs (food,cash, etc.). These practices also promote recycling of crop residues for soil enrichment. The common non-millet crop components are pigeon pea (*Cajanus cajan*), mustard (*Brassica juncea*), Lablab bean *(Lablab purpureus*), maize (*Zea mays*), pumpkin *(Cucurbita moschata*). However, seeds of these crops are mixed in different proportions and broadcast, most often, using a high seed rate.

The small millet grains, unlike the principal cereal grains, have superior nutritional profile for more than one dietary component. From the proximate chemical analysis of grains (Annexure 2), it is evident that these millets have substantial superiority in dietary fibre, calcium, iron, phosphorous and vitamins such as thiamin, riboflavin, niacin, and total folic acid. In addition, they possess comparatively higher amount of amino acids, such as phenylalanine, histidine, leucine, isoleucine and valine and marginally higher content of lysine, methionine and tryptophan. In view of such superior nutritional profile, Prof. M.S. Swaminathan suggests that these grains should be appropriately called as “nutritious millets” rather than being called by devaluing terms like ‘coarse grains’. The higher fibre content and unique carbohydrate properties of these grains confer important neutraceutical property to them. Their low glycemic

index is earning them increasing recognition as a diabetic food. There are also reasons to believe that there is considerable useful variability among nutritious millets for different critical nutritional constituents.

Gender Issues in Production and Post Harvest processing processes: Despite its nutritional importance and climate resilient traits, they were often neglected and an underutilised species (NUS) in India. At the small and marginal farm holdings and households, women's drudgery in production and post-harvest processing is one of the reasons for the neglect of millets. Besides, lower profitability of millets in cash per acre of land compared to alternatives available-requirement of more female labour for weeding; drudgery in pounding and lack of processing machines for little and Italian millets, weeding difficulties in millet farming are other reasons for neglecting them in farming and its use as food.

Table 1. Trend in Cultivation area of small millets, Tapioca and Pine Apple (in Ha) in Kolli Hills

Year	Small Millets	Finger Millets	Tapioca	Pine Apple
1970-1971	1799	N/a	0	40
1995-1996	950	N/a	2020	740
1996-1997	967	N/a	5000	900
1999-2000	645	841	6255	323
2000-2001	501	991	6254	295
2001-2002	651	756	5891	616
2002-2003	782	750	2454	602
2003-2004	101	509	6221	610
2004-2005	152	78	6436	608
2005-2006	184	81	7170	604
2006-2007	177	90	6701	563
2007-2008	160	86	6332	543
2008-2009	154	77	5974	566
2009-2010	146	68	5675	565

Objectives, Methods and Research tools

The objective of this participatory research was to reduce the drudgery arising from certain traditional production and post-harvest operations and introduce the improved processing

technology to achieve higher quality and grain recovery. The benchmark study and focus group discussion conducted in the project villages among the farmers was to understand the level of participation of women and men in production and post-harvest processing practices.

Participatory technology development and refinement, individual discussion, participant observation and demonstration were used to understand the extent of drudgery of on-farm and post-harvest processing activities such as sowing, inter-cultivation, weeding, harvesting, winnowing and post-harvest processing in millets.

The benchmark study conducted in the project villages among 125 households involving adult men and women in the small and marginal farm-family, in the age group25 to 60. It indicates that women participate in over 60 per cent of the activity related to production and post-harvest processing practices. Most of the activities carried out by women involve labour, time and drudgery.

Based on the gender role analysis in millet farming, the interventions that would help reduce women labour time and drudgery in production and post-harvest processing activities were identified and tested.

Drudgery-reducing farm implements (rowmakers, starweeders, modified spades) were demonstrated in farm operations and dehusking and pulverising machines introduced to test the efficiency in reducing drudgery and saving time. The field data collected and analysed are presented in this paper.

Findings and Discussion:

Gender division of roles in millet farming, processing and consumption, indicate that women play a predominant role at every stage (Table 2). Many of the on-farm and post-harvest operation in millet farming are performed by women and that is one of the reasons why men are less bothered about growing millets than women. It also demonstrates that women are being enabled to take decision to grow millets, and then do more with value addition. It is worthy to note (Table 2) that many cumbersome tasks such as hand weeding, harvesting, threshing, cleaning and drying work are the tasks of women. Post-farm gate operations such as manual pounding and pulverising are the exclusive work of women. MSSRF introduced several methods to improve productivity through improved agronomic methods such as row planting with reduced seed rate, application of inputs, proper weeding and thinning as compared to

conventional method of broadcasting and no external inputs and intercultural operations. These new methods imposed workload and drudgery to women as indicated in Table 3. To address these women specific production and processing constraints specific farm implements and processing equipments were introduced.

Table 2: Gender Role in millet cultivation, processing in Kolli Hills

Activities of Millet Cultivation	Decision Making (%)			Work Participation (%)		
	Men	Women	Both	Men	Women	Both
1. Selection of crop for cultivation	44.16	27.27	28.57	36.51	19.05	44.44
2. Selection of variety (seed)	45.95	35.14	18.92	42.86	30.16	26.98
3. If seed is purchased, who decides & do	49.33	34.67	16.00	43.94	25.76	30.30
4. Field cleaning	31.58	32.89	35.53	17.81	31.51	50.68
5. Land preparation (ploughing or digging)	65.79	14.47	19.74	54.67	16.00	29.33
6. Transport & application of manure	54.93	18.31	26.76	42.86	18.57	38.57
7. Seed treatment	36.84	42.11	21.05	47.37	42.11	10.53
8. Sowing seeds (broadcast/row planting)	45.45	27.27	27.27	44.00	24.00	32.00
9. Chemical fertilizer application	55.36	25.00	19.64	51.79	25.00	23.21
10. Hand weeding	10.00	58.55	30.00	11.59	62.32	27.54
11. Interculture/mechanical weeding	11.36	70.45	18.18	4.55	70.45	25.00
12. Plant protection measures	21.92	27.40	50.68	16.44	30.14	53.42
13. Watching from crop damage	16.44	28.77	54.79	24.66	24.66	50.68
14. Harvesting main crop	11.84	39.47	48.68	6.76	45.95	47.30
Activities of Post Harvest processing, Storage and Market						
15. Threshing & cleaning	9.33	50.67	40.00	5.48	52.05	42.47
16. Cleaning & drying grain	5.33	58.67	36.00	6.85	60.27	32.88
17. Transporting the grain	26.76	30.99	42.25	18.31	35.21	46.48
18. Drying grain e.g seed/consumption/marketing	11.76	51.47	36.76	8.96	52.24	38.81
19. Storage of grain	11.86	47.46	40.68	8.96	56.72	34.33
20. Seed selection and storage	21.31	31.15	47.54	18.33	30.00	51.67
21. Marketing of grain/fodder	22.81	28.07	49.12	25.00	25.00	50.00
22. Receiving & handling the money	10.77	50.77	38.46	12.31	47.69	40.00
23. Marketing of grain/fodder	41.18	26.47	32.35	38.24	29.41	32.35
24. Receiving & handling the money	32.50	37.50	30.00	30.00	40.00	30.00

Table 3: On-farm and Off-farm drudgery for women and reducing methods/ farm implements

Activity	Issues related to Drudgery	Suggested methods
Sowing operation	Women are strained to place the seeds	Introduce row maker to reduce labour time/strain.

	in bending posture	
Inter cultivation	Require more time and energy to women	Inter cultivation hoe Variable size spades
Weeding	Done manually by women in a squatting posture which is strenuous.	Introduce starweeder to reduce time and labour
Post harvest Processing of Italian and Little millets	Done manually by separating the stones, then by hand pounding and winnowing	Processing equipment including destoner, grader for cleaning , emery mill and roller dehusking
Post harvest Processing of Finger millet	Done manually by separating the stones, then by hand grinding in stone marter and winnowing	Processing equipment including destoner, grader for cleaning , and pulveriser

The sowing operation and row marker: Traditionally, the broadcasting of seeds was done by men in monoculture and mixed cropping. To increase productivity line sowing was introduced as an improved agronomic practice. In the intercropping situation farmers adopt line sowing along the rows marked by rope. This method enhanced drudgery as walking for long distances was necessary. Introduction of row planting without suitable tools resulted in high labour demand and cost. This was addressed by devising low cost row markers using local material with the help of local artisans. The row marker designed in Kolli Hills is a six-row marker, 1m in length. Short marker is preferred in Kolli Hills in view of narrow terraced land in steep slopes. The marker can be drawn either by bullocks or persons. The millet seeds are planted on the rows. Demonstration of the row marker was conducted to train both men and women on its use and make them understand its advantage. This generated great interest among farmers and created high demand for row markers. The experiential learning had contributed substantively for promoting row planting.

Table.4 Drudgery Reduction - Making row for line sowing

Details	**Traditional method**	**Improved method**
Name of instruments	Hand hoe using rope	Row maker
Size of instrument	Nil	One meter length with six blades
	Both	Both
No. of person for doing work for an acre	Three persons	Two persons
Time for doing work for an acre	Eight hours/person(Total time: 3 persons x 8 hours = 24 hours)	One hour/person(Total time: 2 persons x 1 hour = 2 hours)

Differences between manual sowing in lines and sowing using row makers	-	80 per cent of traditional methods' time saved

Table 4 indicates that 80 per cent of women-time was saved. The time taken for manual methods of making of row for line sowing in acre used 24 hours of female labour time, but by using row maker, the time reduced to 2 hours and only two women's labour was needed .

Spade for weeding in Millets intercropped with Tapioca

Weeding of tapioca is done by women using a spade, which is about 4 inch width and 7 inch length. Introduction of finger millet between rows of tapioca caused problems to women in using the wide spade for weeding. This was addressed by modifying the spade width to about 6 cm and conducting efficacy study of the new spade. The new spade is found by women as most suitable to the tapioca-millet intercropped with Tapioca as they found it weightless and easy to operate between rows. Table 5 shows that weeding in one acre of tapioca intercropping field using conventional spade,72 hours of female labour time is needed. In the case of modified spade, 42 hours of women's labour time is needed. It shows that 40 per cent of women saved time by introducing the simplified spade for weeding in tapioca inter-crop.

Table.5 Drudgery Reduction - Modified spade for weeding in tapioca field

Details	**Traditional method**	**Improved method**
Name of instruments	Traditional spade	Modified spade
Size of instrument	4 inches width and 7 inches length	6 inches width and 9 inches length
Done by whom (Male/Female/Both)	Women	Women
No. of persons for doing work for an acre	12 women	7 women
Time for doing work for an acre	6 hours (Total time: 12 persons x 6 hours = 72 hours)	6 hours (Total time: 7 persons x 6 hours = 42 hours)
Differences between traditional and improved methods	-	40 per cent of traditional methods' times saved

Weeding and Starweeder: The row-planted fields allowed the use of semi-mechanized Starweeder - a weeding tool used to weed in rainfed regions and manually operable, which can be operated by both women and men. The manual weeding required the women to work in bending posture for long hours and this has been causing back pain and other problems. The

starweeder avoided this painful outcome apart from lesser time for weeding. Table 6 illustrated that. In case of weeding of one acre using conventional spade, it took 72 hours of female labour time but while using Star weeder, 24 hours of female labour time is required, therefore about 75 per cent of women labour and drudgery is reduced.

Table.6 Drudgery reduction activity for weeding in line sown millets

Details	**Traditional method**	**Improved method**
Name of instruments	Traditional spade	Starweeder
Size of instrument	4 inches width and 7 inches length	Nil
Done by whom (Male/Female/Both)	Women	Both
No. of person for doing work for an acre	12 women	Four person (Male /Female
Time for doing work for an acre	6 hours/person (Total time: 12 persons x 6 hours = 72 hours)	6 hours/person (Total time: 4 persons x 6 hours = 24 hours)
Differences between traditional and improved methods	-	75 per cent of traditional methods' times saved

Similarly, to address the post harvest processing difficulties and drudgery, close observation was made to design customised processing technology and prototypes for different species of millets. The traditional processing of small millets like little and foxtail millets is very laborious using wooden mortar and pestle, which normally is done by women. It takes continuous pounding for an hour to pound 2-3 kg grain of millet grains, other than the finger millet. All minor millets except finger millet have a tough outer coat requiring heavy searing action for their dehusking or decortication. Finger millet possessing lighter seed coat is directly milled to flour for use. Traditionally this milling is done in manually using operated stone grinder, which is also tedious. This drudgery in processing the grain for consumption and the shorage of time of the farm women attend to such long operations discouraged the household consumption of these grains when rice was readily available through public distribution systems. These factors had significant impact on the production of millets.

Finger millet processing and pulverising machines: Village level finger millet pulverising machines were introduced to reduce the drudgery of women and promotion of finger millet consumption. The drudgery involved in the traditional grinding of finger millet is in the use of manually operated grinding stone. Introduction of this pulveriser mill has reduced the

drudgery of women and also 90 per cent of women-time saved. Table 5 indicates the performance of the mechanical pulveriser. The conventional method of grinding of one kg of finger millet took 2 women hours, but, using mechanized pulveriser, only 10 minutes for one woman. So it shows that 90 per cent of work load and drudgery of women is reduced.

Table.7 Drudgery Reduction – Pulverizing

Details	**Traditional method**	**Improved method**
Name of instruments	Traditional wooden device	Pulverizer flour mill
Done by whom (Male/Female/Both)	Women	By machine
No. of person for doing work for a one kg	2 women	One man or woman
Time for doing work for a one kg	One hour / person (Total time: 2 persons x 1 hours = 2 hours)	Ten minutes/person (Total time: 1 person x 10 minute = 10 minutes)
Differences between traditional and improved methods	-	90 per cent of traditional methods' times saved

Establishment of mechanical de-husking machine

Another important intervention for reduction of drudgery of women in post-harvesting process especially on de-husking of little millet, foxtail millet and proso millet is introduction of mechanical dehuller. These small millets are minor grains with a near spherical shape, an average axial length of 1-1.5 mm and encased by an indigestible single layer hull. The removal of this hull along with the separation of the hull from the edible grains is essential before consumption. The dehulling of small millets using pestle and mortar is tedious and involves drudgery (Table 8). The local prototype-based mills result in significant amount of broken grains, which is undesirable. These existing mills also entail a lot of drudgery for the mill manager who further separate the de-hulled grain from the hulls. In response to these concerns, a centrifugal mill was designed and prototyped in Dharwad, India in 2011. The mill was then re-configured in Montreal, Canada to use rubber rollers which resulted in fewer broken grains as compared to the centrifugal mill. The original centrifugal portion was therefore used as a fan as a means to separate the cleaned grain from the hulls which decreases women's drudgery associated with cleaning the grains. Although the efficiency of the rubber roller mill in laboratory condition witnessed 90% recovery of full grains, multiplication trial conducted in

Kolli Hills resulted in showing the recovery range of 82-85% that indicates that further research and refinement is needed. However, this research advancement is advantageous as compared to the currently used emery mill that offers 55%-65%, since the former doesn't cause as many broken grains as the latter. The rubber roller mill has been shown to decrease women's drudgery by eliminating the time required for winnowing since it separates the de-hulled grain from the hulls. Although the rubber roller mill had proven a capacity of about 6kg/h which is adequate for village use at the household level, multiplication trials indicates that 5kg/2.30 hrs, thus requires further refinement in technology. The rubber roller mill with 0.5HP motor is more appropriate and accessible for household level use than the emery mill since the former uses single phase electrical power, while the latter uses 3-phase electrical power which is not available for domestic electricity connections at the household level and also costs more per kWh of electricity, making the cost of operation cheaper for the rubber roller mill. Since the rubber roller mill uses shearing force rather than abrasive force like in the emery mill, the bran remains on the grain which provides increased nutrition as compared to the millet that has gone through the emery mill. The new technology extended to de-hull millet can help in improving the livelihoods and food security of rural families through value-added products and improving nutrition. Table 5 and Table 6 shows that the differences in manual processing- Emery mill and improved mechanical rubber sheller de-husking methods.

Table 8 Manual and Mechanical dehusking of Little Millet (Emery Mill Type)

Processing Type	Not Dried /Dried	Grain Qty In Kg	No of MP /MD*	Dur. in Hrs	Recovery in Kg	Broken Rice Waste and Husk in Kg
Manual	Not Dried	5	3	3.15	3.250	1.750
Mechanical	Not Dried	5	4	0.04	3.00	2.000

*MP – Mannual Pounding, MD – Mechanical Dehusking

Table.6 Multi-location Appraisal of Little Millet (McGill Prototype) Dehulling Machines

Region	Location	Grain Qty In Kg	Recovery in Kg	Husk mixed with rice in Kg	No of Time Passing	Duration for Dehulling/ 5kg (hr:m:s)	Electricity Unit (kwh)
Kolli Hills	Puliyampatti	5	4.100	0	8 Times	2:15:17	1
	Keeraikkadu	5	4.200	0	8 Times	2:10:20	1
	Chinnamangalam	5	4.275	0	8 Times	1:44:10	1
	Namakkal	5	4.260	0	8 times	2:21:20	1

Elimination of gender-based drudgery associated with the on-farm production and traditional grain processing with the introduction of locally suited machinery made a difference on the nutritional advantages of these grains; farm implements and processing technology facilitated demand for local consumption. In addition, grain processing opened new opportunities for production of traditional and novel value-added products and their commercialization for enhancing employment and income generation. These efforts in revival of nutritious millet conservation with an embedded economic stake have led to increased interest among the communities on small millets, increasing household consumption of these nutritious millets and earning more income from increased grain yield, value-added and marketing the value-added products, rather than marketing the grain. This gender responsive approach, as discussed, involves substantial capacity building to the key members of the community, particularly women, and also to other spheres of value addition and marketing as well as building minimal infrastructure and value chain network. These assets were built by their saving and by leveraging through projects and state support systems. The level of self confidence and esteem created by these processes on these women is indeed incredible. They are now exploring the untapped potential in value addition and discovering the nutritional and economic benefits of these millets through value addition and markets.

Time Use Analysis:

The time use analysis indicates that prior to processing intervention women were fully occupied with productive and reproductive and caring work and hardly had leisure time. But now, the introduction of pulversiers and dehullers equipments has saved significant time in the household reproductive work and increased leisure time for the woman and her family. According to these diagrams, there is no change in the time that women spend on productive work. This may mean that the intensity of labour is reduced through technology rather than the hours spent. According to these charts, reproductive work has reduced after the intervention. The time saved from reproductive work is spent on family and leisure.

Figure 1: Time Use pattern of Women before Intervention

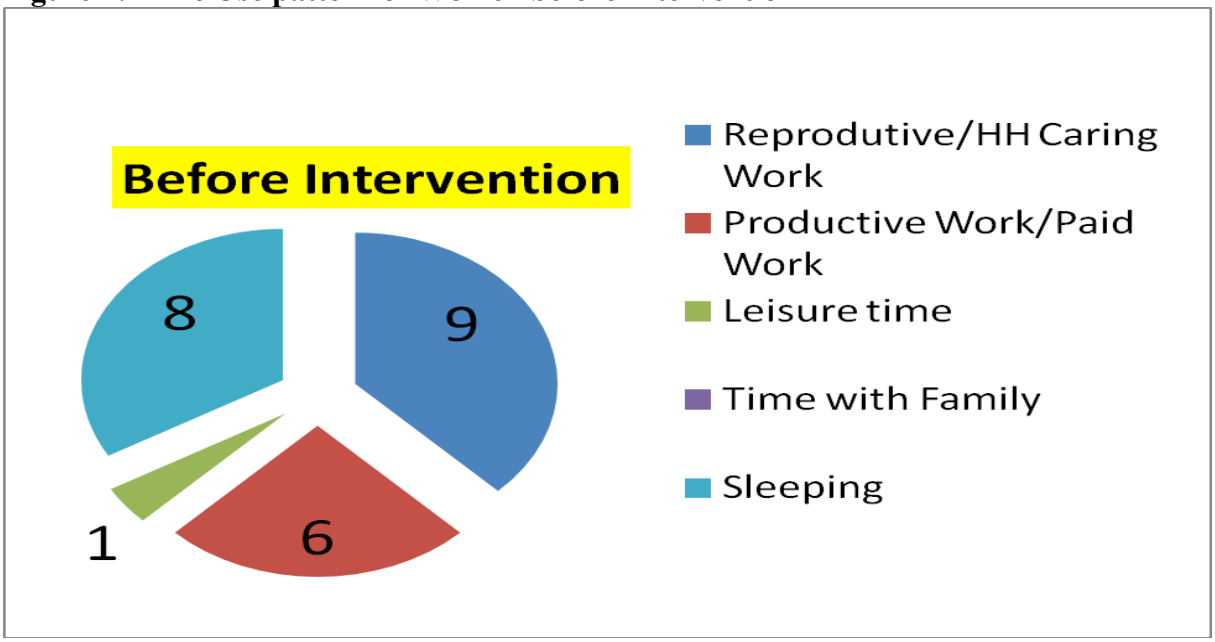
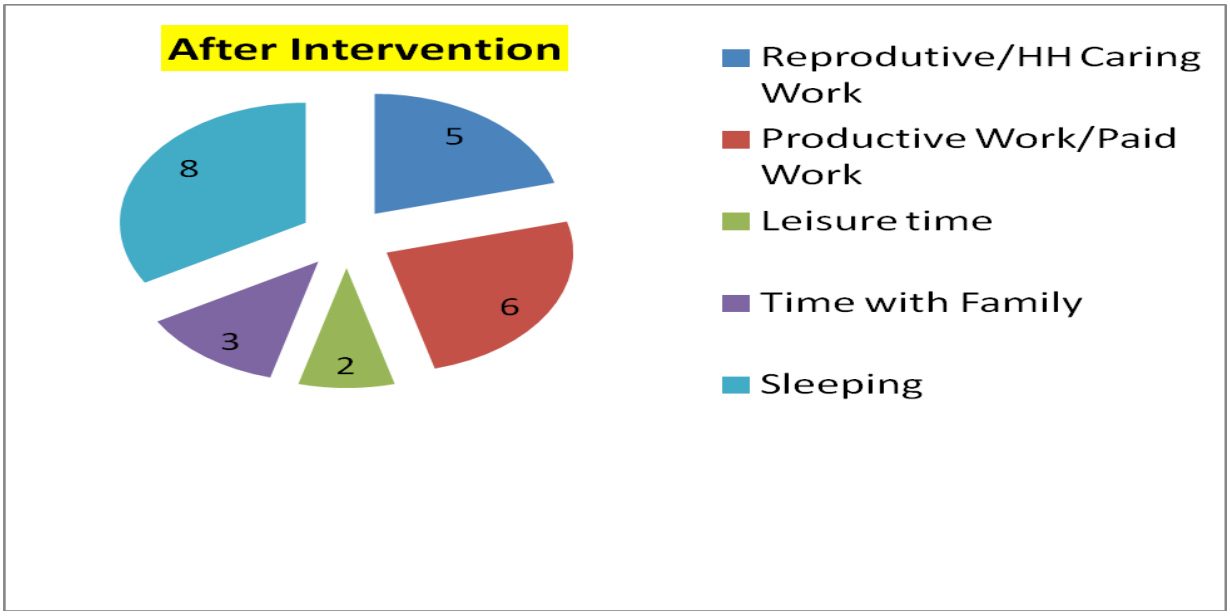


Figure 1: Time Use pattern of Women after Intervention



The current study offers opportunities for further research refinements for energy efficient, cost effective and women friendly technologies and farm implements that can save time, labour, energy and nutritive food crops and also would help us understand the changing gender relationships in the long run.

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Annexure 1. Landraces of nutritious millets in Kolli Hills

Common Name	**Binomial**	**Vernacular Name**	**Land races**
Little millet	*Panicum sumatrense* Roth. ex Roem.& Schult.	*Samai*	*Sadansamai*, *Thirikulasamai*, *Karumsamai*, *Kettavettisamai*, *Kottapattisamai*, *Malliyasamai*, *Perumsamai*, *Vellaperumsamai*, *Elansamai*,
Italian Millet	*Setaria italica* (L.) P.Beauv.	*Thinai*	*Senthinai*, *Palanthinai*, *Karunthinai*, *Perunthinai*, *Killanthinai*, *Koranthinai*, *Mosakkannathinai*, *Mokkanathinai*
Finger Millet	*Eleusine coracana* (L). Gaertn.	*Ragi / Arium / Kelvaragu*	*Sattaikevaru, Karakelvaragu, Perunkelvaragu, Elankelvaragu, Sundangikelvaragu*
Common Millet	*Panicum miliaceum* L.	*Panivaragu*	
Kodo Millet	*Paspalum*	*Varagu*	*Peruvaragu*, *Thirivaragu*,

	scrobiculatum L.		*Karunkalivaragu*, *Senkalivaragu*.

Source: Vedavalli.L., Rengalakshmi. R E.D.Israel Oliver King and K.Balasubramaian.1999. Biodiversity, Under-utilized crops and socio-cultural dimensions in an historical perspective. Paper presented at Consultative workshop on Enlarging the basis of food security: role of under-utilized species, held at M.S.Swaminathan Research Foundation, Chennai, 17-19 February, 1999.

Annexure 2. Proximate chemical composition of major cereals and minor millets (per 100 g)

Crops	Caloric value (k cal)	Protein (g)	Fibre (g)	Calcium (mg)	Iron (g)	Phosphorous (mg)	Thiamine (mcg)	Riboflavin (mcg)	Niacin (mcg)	Total Folic acid (mcg)
Rice	345	6.8	0.2	10	0.7	160	0.06	0.06	1.9	8.0
Wheat	346	11.8	1.2	41	5.3	306	0.45	0.17	5.5	36.6
Finger millet	328	7.3	3.6	344	3.9	283	0.42	0.19	1.1	18.3
Italian millet	331	12.3	8.0	31	2.8	290	0.59	0.11	3.2	15.0
Little millet	341	7.7	7.6	17	9.3	220	0.30	0.09	3.2	9.0

Source: B.S. Narasinga Rao *et al.*, 2007; In Nutritive value of Indian Foods, National Institute of Nutrition, Hyderabad, India.

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