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Adoption of drudgery reducer tools used for different farm and allied activities by rural women of Assam

Porna Sarmah, Nasima Farhana Ali and Dipshikha Hazarika

Abstract
Women play an important role in agriculture and allied sector. The nature and extent of their involvement varies from states to states but regardless of these variations rural women's livelihood identifies a 'triple burden' of work in terms of productive, reproductive and social spheres. The farm women perform grueling work in crop field as well as in homestead activities. This cause physical as well as mental exhaustion and other health problems. The foremost reasons of these problems are hoary techniques of performing work, unawareness about different drudgery reduction tools, incompatibility and attitudinal constrains such as instinctive conservatism and confrontation to change. Hence, the present study was carried out in 3(three) districts of Assam *viz*. Kokrajhar, Nalbari and Lakhimpur with the objective to study the adoption rate of selected drudgery reduction tools by farmwomen of Assam. Total sample of 120 respondents were randomly selected from 6 numbers of villages of the three districts. Personal interview method with a structured questionnaire was used to collect the data from the respondents. Frequency and percentage were used for analysis of the data. Findings revealed that majority of the agricultural and allied activities were perceived as difficult to perform by the farm women. Intervention programmes on drudgery reduction technologies for farm women conducted by different Krishi Vigyan Kendras of Assam were found to be effective which is indicative from the knowledge and adoption level of the farmwomen on technologies and some tools demands further up-gradation or modification.

Keywords: Drudgery reduction tools, adoption, harvester, ergonomics, exertion, workload, farmwomen

Introduction
In North-eastern region, women play an important and significant role in agricultural and allied sector which includes crop production, livestock maintenance, horticulture, harvesting and post-harvest/value addition operation of various crops, tea plantation, fishing, sericulture, and weaving etc. The nature and extent of women's involvement in agriculture varies greatly from states to states but regardless of these variations, women are actively involved in various agricultural and related activities, Chavan, *et al*., 2021 [10].

Kattel (2019) [1] states that rural women's livelihood identifies a 'triple burden' of work in terms of productive, reproductive and social spheres. Migration of economically active men to other countries or to urban area for better jobs, the agricultural labour is being increasingly feminized. Economic Survey 2017-18 also emphasized in the same context that with growing migration rate by men from rural to urban areas, there is 'feminization' of agriculture sector which directly influence the rural women folk by involving women in multiple roles such as cultivators, entrepreneurs, and laborers. In addition to that most of the farm women belongs to below poverty line and face financial hardship which directly or indirectly influence their nutritional status and health conditions. Shabanali, *et al*., (2002) [3] states that nutritional status plays a major role in the productivity of women in mixed farming and has negative effect on women's physical work. The farm women perform grueling work in crop field as well as in homestead activities. This cause physical as well as mental exhaustion and other health problems. The foremost reasons of these problems are hoary techniques of performing work, unawareness about different drudgery reduction tools, incompatibility and attitudinal constrains such as instinctive conservatism and confrontation to change. Women feels hesitate and are lagging behind to use improve technology and tools in farm to reduce drudgery. However, many agricultural tools are designed considering men's workload, anthropometric, physiological characteristics, ergonomic parameters and occupational disorder and are sometimes unfit and uncomfortable for female. Therefore, developed farm equipments needs to address and assess gender issues in terms of dimension, strength, posture, safety and social aspect which can enable the equipment to be workers friendly or gender friendly.

The new technologies must be emphasized on growth in agriculture which requires recent knowledge, skill and different sources of information for farm women. Training and demonstration of advance and upgraded technologies is important need of farming community in technological era. Therefore, to inculcate sound, practical oriented, need based, location specific and to know new innovation in agriculture and allied sectors training and awareness plays a vital role and thus help to take appropriate decision at the time of need. Krishi Vigyan Kendra (KVK) is the light house for rural people and known as innovative science-based institution which disseminates different vocational/skill development trainings, conducting on farm trial/research on technology refinement, organized front line demonstration to promptly demonstrate the updated technology to farmers and extension functionaries. The KVKs has been playing a vital role in imparting various activities to farm women through 'learning by doing' which not only increase their knowledge and skill but also address drudgery reduction during farm operations. Hence, various drudgery reductions cum ergonomically designed tools were popularized and disseminated especially to women folk in the state by conducting on farm trial and front-line demonstration in farmer's field.

Hence, the impact analysis of adoption rate of various drudgery reduction tools used in agriculture and allied sector by rural women folk in selected district of Assam will provide an overview to extensionists, researchers, agriculture planner and policy maker with information that is essential for the establishment or accomplishment of refined and improved technologies. It is because women empowerment in agriculture or allied sectors as a part of human resource development is influence by many important factors such as education and awareness, health and nutritional status, appropriate cost-effective drudgery reduction technologies, etc. Although these factors are inter-related, workers friendly ergonomic-approach, adoption rate of available drudgery reduction tools and constraints faced by both the gender needs to be addressed. Keeping these in view the present study was carried out in 3 districts of Assam *viz*. Kokrajhar, Nalbari and Lakhimpur with the following objective:

To study the adoption rate of selected drudgery reduction tools by farmwomen of Assam.

Methodology

Villages under Krishi Vigyan Kendra (KVK), Kokrajhar (under Lower Brahmaputra valley zone in Bodoland Territorial Region of Assam); KVK, Nalbari (plain Brahmaputra valley zone under lower sub division) and KVK, Lakhimpur (under North Bank plain Zone) of Assam were purposively selected based on different agro climatic zones of agriculture for the study where drudgery reduction tools were distributed under OFT and FLD programmes.

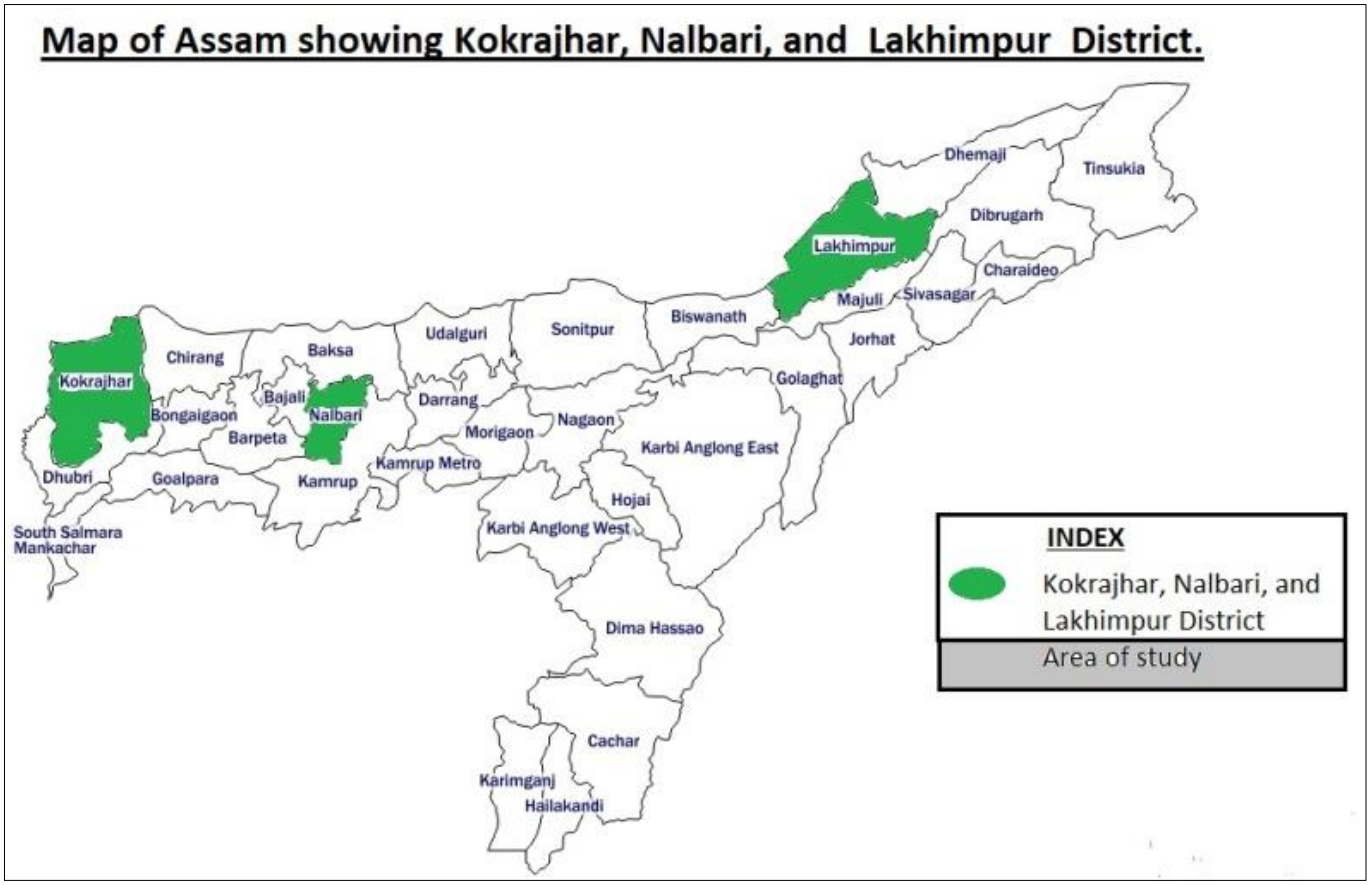

Fig 1: Showing area of study

Keeping in view the objective of the study, total sample of 120 respondents were randomly selected from KVK beneficiaries from 6 numbers of villages *viz*. Maktaigoan and Koklingbari under Kokrajhar District; Balitara, Borhorkuchi villages in Nalbari district; Bogonodi and Azad villages in Lakhimpur district 20 numbers of respondents from each village where drudgery reduction tools and technologies were disseminated. Personal interview method was used to collect the data from the respondents. Frequency and percentage, were used for analysis of the data.

Development of tools

An exhaustive reviewing of literature assisted and enabled the researchers to develop the tools. A structured questionnaire was developed to get information under various heads as given below-

- Demographic profile of farm women,
- Agricultural and livestock activities performed by farm women,
- Their perception of agricultural and allied activities with regard to workload.
- Knowledge and adoption level of respondents in respect of drudgery reduction technologies. Knowledge was evaluated on the basis of their knowledge regarding name and purpose of the technology, features, cost and place of availability/ procurement of technology. Further, to analyze the occupational workload of farmwomen performing manual activities was appraised through modified scale of perceived exertion as it was based on strong relationship between physiological response and subject feeling of exertion. The collected data were coded and tabulated by using statistical tools. The analyzed data were interpreted to get meaningful findings.

Results and Discussion

Socio economic profile characteristics of respondents

The social variables of 120 respondents from three districts were presented in Table 1.1

Table 1: Distribution of Farm women according to their social variable (n=120)

Sl. No.	Background information		Frequency	Percentage
1	Age	18-25 years	12	10
		26-35 years	37	30.8
		36-45 years	32	26.6
		46-55 years	33	27.5
		55 and above	6	5
2	Educational level	Illiterate or informal schooling	5	4.16
		Primary (1 to 4th Std)	6	5
		Middle school (5-7th std)	18	15
		Higher school (8th to 10th Std)	47	39.1
		Higher secondary (11th to 12th Std)	32	26.6
		Graduate (more than 12th Std)	12	10
3	Family Type	Joint	45	37.5
		Nuclear	66	55
		Extended	9	7.5
4	Occupation	Labour	11	9.1
		Farming	64	53.3
		Weaving- Housewife	26	21.6
		Own business	19	15.8
5	Annual income of the Family (in Rs)	Less than 1 lakh	47	39.1
		1-2 lakhs	30	25
		2-3 lakhs	21	17.5
		3-4 lakhs	11	9.16
		4-5 Lakhs	11	9.16

Table 1 reveals socio-economic profile characteristics of farm women in accordance with the age group, educational qualification, family type, occupation and annual income of family.

First categories ranges from farm women aged between 18 to 55 and above age. Though maximum young women range from 26 to 35 years aged group (30.8%) and old aged women aged between 46-55 were more involved in performing agricultural and allied activities (27.5%) followed by 46-55 years (27.5%) and 36-45 years (26.6%). Hence, the table reveals that women range between 26 to 45 aged are actively involved in agriculture and farm activities as they are confident and skilled enough in agriculture and allied field and is a leisure time activity for them.

As far as educational status is concern, majority (39.1%) of them were educated up-to 8th to 10th standard. 26.6% were educated up-to 10th to 12th standard and 29.16% are under categories of illiterate to middle school.

In terms of family type was categorized as joint, nuclear and extended. More than half of the farm families are nuclear (55%) and 37.5% as joint family.

Regarding occupational status most of the respondent were actively involved in farming (53.3%) and simultaneously they were also doing weaving (21.6%) and involved in marketing their own products. They sold the perishable and non-perishable goods like vegetables, fruits, milk, meat, grains, eggs, hand-woven cloths, etc., in local market (15.8%).

Moreover, annual income of family in terms of rupees were ranges as less than one lakh,1-2 lakhs, 2-3 lakhs, 3-4 lakhs and 4 lakhs and above. 39.1% farm family were less than one lakh annual income, 25% having 1-2 lakhs followed by 17.5% have annual income ranges from 2-3 lakhs and very few (9.16%) have income ranges from 3-5 lakhs annually.

Table 2: Distribution of respondents by their economic variable (n=120)

Sl. No.	Economic variables		Frequency	Percentage
1	Land holding	Marginal Farmer (Up-to 1 ha)	12	10
		Small Farmer (1.1 to 2 ha)	44	36.6
		Medium Farmer (2.1 to 4 ha)	55	45.8
		Big Farmer (more than 4.1 ha)	9	7.5
2	Housing	*Kutcha*	11	9.16
		Mixed	78	65
		Puccka	31	25.83
3	Livestock ownership	Small herd Size (1-3)	43	35.83
		Medium Herd Size (4-10)	47	39.16
		Large Herd size (above 10)	30	25
4	Dwelling of livestock	Open/Nil	12	10
		Thatched */kuttcha*	89	74.16
		Puccka	19	15.83
5	Handloom ownership	Ordinary loom	42	35
		Fly shuttle Loom	76	63.33
		Jacquard loom	2	01.6
6	Dwelling of Handloom	Varanda /open	45	37.5
		Thatched */kuttcha*	54	45
		Puccka	21	17.5
7	Media Ownership	Nil	6	5
		Print media (Newspaper/magazine)	11	9.16
		Audio Aids (Radio/transistor)	12	10
		Audio- Visual (Television, Mobile)	91	75.8
8	Vehicle ownership	Bicycle	101	84.16
		Motorcycle (bike/scooty/scooter)	41	34.16
		Four-wheeler	12	10
		Tractor	11	9.16
		others	4	3.3

Table 1.2 reveals that 45.8% of farm women was medium farmer having land holding 2.1 to 4 ha and more than one fourth (36.6%) of respondents were small farmers having land holding 1.1 to 2 ha. Only 7.5% farmers having big land holding i.e., more than 4.1 ha and 10% of farmers were marginal farmers having less than 1 ha of land.

More than half of the respondent having mixed type of house (65%) and 25.83% having *paccka* house, some of are constructed under *Indira awas yojana*, GOI and some were under construction.9.16% have fully *katcha* house.

Livestock ownership was found to be 39.16% for medium herd size followed by small herd size (35.5%).one- fourth of the respondent have big herd size i.e., above 10. Livestock was dwelled in *katcha* house i.e., 74.16%. Livestock which were found reared in the house of respondent were pig farming, poultry, duckery, goatery, dairy etc.

Assam has a great textile tradition. Since time immemorial Assamese women, irrespective of caste and social status, have been weaving the daily requirement of the cloth and apparel and this art was transferred from generation to generation by Assamese women folks especially to those who are excelled in weaving beautiful design in their looms (Bajpeyi, 2010) [11]. Earlier ordinary loom were used but now fly shuttle loom, jacquard looms were also used by many weavers of Assam. During the study 63.33% practice weaving in fly-shuttle loom and 35% possess ordinary loom. A meager portion (1.7%) have jacquard loom facility.45% weavers have dwelling for handloom and 35.5% kept their loom in *varanda* or open space.

In regards with media ownership, 75.8% of respondent use audio visual aids like Mobile, television) but most are key pad mobile and were not smart phone. 40.83% household have television facility. They watch Television mostly during night time but frequent power-cut make them inconvenience to watch some important programme, stated by most of the respondent. 9-10 percent respondent use print media and audio aids like radio and transistor.

Almost (84.16%) have bicycle; 34.16% have motor cycle. Few have four-wheeler (10%), Tractor (9.16%).

Agricultural activities performed by farm women

The investigator tried to find out the different agricultural and allied activities performed by farm women. The distribution of various work among the respondents were shown in Table 2.

Table 2 shows that apart from women involving in household chores like cooking foods, child and family care, etc., majority of women were also involved in many agricultural activities like land preparation where more than half of the farm women were involved in digging (65.0%), cleaning of land and jungle (63.3%), and clod breaking (54.1%). In this same context, Aggarwal *et al*. 2013 [4] also stated that majority of farm women were performing various agricultural activities such as cleaning of field, raising nursery bed and seedlings, sowing, transplanting, harvesting of crop, threshing, winnowing, shelling, cleaning and drying of grains. Moreover, majority of farm women also engaged in sowing (85%), manuring (83.3%), irrigation (90.8%), weeding (85%), crop cutting (86.6%), drying of grain (90.8%), storage and maintenance of grains, post-harvest and value addition (88.3%) and various allied activities like sericulture, weaving, livestock rearing and maintenance, etc. Hence, it can be said that women are playing a noteworthy role not only in agriculture but also in allied sectors such as animal husbandry and weaving are also a domain where women are participating more than men.

Table 2: Distribution of farm women according to agriculture and allied activities performed (n = 120)

Sl. No.	Activities	Agricultural and allied activities	
		n	Percentage (%)
1	**Land preparation**		
	Cleaning of land and jungle	76	63.3
	Labeling and making ridge/farrow	78	65.0
	Clod breaking	65	54.1
	Digging	78	65.0
	Ploughing	79	65.8
	Harrowing	45	37.5
2	**Sowing and transplanting**		
	Seed Treatment	98	81.6
	Sowing	102	85.0
	Transplanting	108	90.0
	Vegetative propagation	101	84.1
	Layout and seed bed	98	81.6
	Planting	99	82.5
3	**Crop care**		
	Manuring/ Fertilizer	100	83.3
	Irrigation	109	90.8
	Gap filling & re-sowing/thinning	106	88.3
	Weeding & inter-Culture	102	85.0
4	**Harvesting**		
	Harvesting of grains	104	86.6
	Picking & cutting	102	85.0
	Vegetable plucking	104	86.8
	Fruit picking	106	88.3
	Planking	103	85.8
5	**Post harvesting**		
	Shelling	98	81.6
	Stripping	94	78.3
	Decortications	88	73.3
	Sieving grain	101	84.1
	Threshing & winnowing	103	85.8
	Drying	109	90.8
	Sun-drying of grain	109	90.8
	Value addition of grains, vegetables	106	88.3
6	**Livestock activities**		
	Fodder Collection/ Feeding	78	65.0
	Cleaning and care of animals/Poultry	103	85.8
	Cleaning of animal/ poultry shed	103	85.8
	Disposal of animal excreta	103	85.8
	Milking of animal/Collection of eggs etc.	98	81.6
7	**Handloom**		
	Yarn collection and bobbin winding	109	90.8
	Sizing, dressing and winding of warp yarn	109	90.8
	Attaching warp yarn on loom	109	90.8
	Weft yarn winding	109	90.8
	Weaving fabric in loom	109	90.8
	Marketing	87	72.5

Perceived work load of farm women in agricultural and allied activities

Some agricultural activities are perceived difficult to perform, some can perform moderately and some activities can be perceived easily and light for farm women according to workload and feeling of exertion.

It was observed that land preparation like cleaning of jungle, clod breaking, digging, and ploughing were difficult to perform by majority of farm women. However, seed treatment, sowing etc. were perceived as moderate activities to perform by farm women. Under crop care, farm women stated that irrigation was perceived as difficult to perform if water pump facility and supply of water to the crop field was unavailable otherwise it was perceived as moderate activity to perform. Manuring, fertilizer application, gap filling, re-sowing and thinning, weeding and inter-culture operation in crop field were perceived as moderate activities. All the activities related to harvesting, especially harvesting of grain crops and fruits were difficult to performed as it creates exertion and utmost care while harvesting especially in fruits which are delicate and can damage easily. Harvesting of some vegetables like Okra (*Bhindi*), brinjal, etc. need special care while harvesting as it may create itching and at the same time poor harvesting may damage the crop stated by 50% of farm women. Most of the farm women perceived shelling, stripping, threshing and winnowing in post-harvest operation is most difficult task to perform especially through traditional and old aged techniques or absence of improved tools or device. Sun drying and Sieving grains perceived as moderate activities to perform in post-harvest operations but sometimes leads to back ache and pain in hands as stated by most of the respondent. For livestock activities, care of animals, cleaning

of animal shed, milking, collection of eggs was perceived as moderate activities but fodder collection was perceived as difficult activities for farm women. With regards to handloom weaving, weft yarn sizing, bobbin winding, dressing and winding of warp yarn, attaching warp yarn on loom were perceived as moderate activities but weaving fabric in loom continuously in a sitting position was perceived as difficult activities to perform (55.8%) by farm women. This can be due to improper posture, inadequate tools to reduce drudgery, long duration of repetitive and exhaustive work and lack of proper rest. In this same context, Gora Alok *et al*., (2018) [5] stated that lack of proper rest and inadequate posture were the two main factors to increase drudgery and exhaustion among farm women followed by manual load.

Table 3: Distribution of farmwomen according to their perseverance of work load as well as feeling of exertion while doing agricultural and allied activities.

Sl. No.	Activities	Perception of workload and exertion in agricultural and allied activities					
		Difficult to perform		Moderate activity		Light activity	
		n	%	n	%	n	%
1	**Land preparation**						
1.1	Cleaning of land and jungle	104	86.6	2	1.66	0	0
1.2	Labeling and making ridge/farrow	78	65.0	32	26.6	0	0
1.3	Clod breaking	101	84.1	3	2.5	0	0
1.4	Digging	98	81.6	18	15.0	0	0
1.5	Ploughing	98	81.6	10	8.3	0	0
1.6	Harrowing	87	72.5	20	16.6	0	0
2	**Sowing and transplanting**						
2.1	Seed Treatment	12	10.0	87	72.5	10	8.3
2.2	Sowing	20	16.6	98	81.6	2	1.6
2.3	Transplanting	76	63.3	56	46.6	0	0
2.4	Vegetative propagation	46	38.3	65	54.1	4	3.3
2.5	Layout and seed bed	68	56.6	50	41.6	0	0
2.6	Planting	51	42.5	60	50.0	0	0
3	**Crop care**						
3.1	Manuring/ Fertilizer	32	26.6	78	65.0	10	8.3
3.2	Irrigation	65	54.1	42	35	13	10.8
3.3	Gap filling & re-sowing/thinning	34	28.3	55	45.8	31	25.8
3.4	Weeding & inter-Culture	43	35.8	54	45	37	30.8
4	**Harvesting**						
4.1	Harvesting of grains	61	50.8	51	42.5	0	0
4.2	Picking & cutting	43	35.8	64	53.3	13	10.8
4.3	Vegetable plucking	56	46.6	45	37.5	19	15.8
4.4	Fruit picking	60	50	42	35.0	8	6.6
4.5	Planking	55	45.8	45	37.5	6	5
5	**Post harvesting**						
5.1	Shelling	76	63.3	44	36.6	0	0
5.2	Stripping	63	52.5	42	35.0	15	12.5
5.3	Decortications	45	37.5	46	38.3	29	24.16
5.4	Sieving grain	43	35.8	61	50.8	16	13.3
5.5	Threshing & winnowing	65	54.1	55	45.8	0	0
5.6	Drying	43	35.8	52	43.3	25	20.8
5.7	Sun-drying of grain	50	41.6	43	35.8	27	22.5
5.8	Value addition of grains, vegetables	50	41.6	56	46.6	2	1.6
6	**Livestock activities**						
6.1	Fodder Collection/ Feeding	63	52.5	43	35.8	0	0
6.2	Care of animals/Poultry	45	37.5	53	44.1	2	1.6
6.3	Cleaning of animal/ poultry shed	55	45.8	42	35	20	16.6
6.4	Disposal of animal excreta	45	37.5	61	50.8	2	1.6
6.5	Milking of animal/Collection of eggs etc.	39	32.5	51	42.5	21	17.5
7	**Handloom**						
7.1	Yarn collection and bobbin winding	45	37.5	59	49.1	21	17.5
7.2	Sizing, dressing and winding of warp yarn	32	26.6	69	57.5	19	15.8
7.3	Attaching warp yarn on loom	45	37.5	67	55.8	8	6.6
7.4	Weft yarn winding	38	31.6	58	48.3	24	20
7.5	Weaving fabric in loom	67	55.8	45	37.5	0	0
7.6	Marketing	23	19.1	69	57.5	28	23.3

Hence, it can be inferred from the observations and data that women were involved in tedious, repetitive, labor demanding and more drudgery prone activities. Most of the agricultural and allied activities were done manually as they were not exposed to improved tools to reduce drudgery. Most of the improved tools were not available in nearby market and if available they are of unaffordable price. It was also found that most of the drudgery reduction tools were provided by Krishi Vigyan Kendra (KVKs) only under OFT (on-farm testing/trial) and FLD (front line demonstrations) programmes to women beneficiaries.

Knowledge and awareness regarding drudgery reduction tools

Most of the farm women perform agricultural and allied activities manually and are more prone to drudgery. Poor posture and insufficient rest are also contributing factors. Many farm women were unaware of improved drudgery reduction tools. In addition, farm women were also found with self-made drudgery reduction tools which are not as per standard specification and ergonomically design. Table 4 measures the knowledge and awareness level of farm women on different drudgery reduction tools which was shown as below:

Table 4: Knowledge and awareness of farm women on drudgery reduction tools. (n=120)

Sl. No.	Drudgery reduction tools	n	Percentage
1	Improved sickle	120	100
2	Maize sheller (Tubular)	103	85.83
3	Maize sheller (Rotatory-type)	73	60.83
4	Fruit Harvester	62	51.66
5	Lemon harvester	18	15.00
6	Wheel hoe	120	100
7	Rake weeder	98	81.66
8	Ring cutter	31	25.83
9	Improvised paddy storage structure	32	26.66
10	Improved Grain spreading tool	78	65
11	Paddy stripper	20	16.66
12	Ergonomically design weaving chair (Fly-Shuttle loom)	10	8.33

To measure the knowledge and awareness of respondent on drudgery reduction on selected technologies Table 4 depicted that hundred percentage of respondent were having knowledge on improved sickle and wheel hoe. More than eighty percent of respondents were aware about Rake weeder (81.66%) and tubular hand maize sheller (85.83%) and 60.83% were aware about rotatory-type maize sheller. Half of the respondents were aware about fruit harvester (51.66%). However, less than thirty percent of respondents were aware of Ring cutter (25.83%), Improvised paddy storage structure (26.66%), paddy stripper (16.66%), lemon harvester (15%), and ergonomically weaving chair for fly shuttle loom (8.33%) and hence need extension, awareness and accessibility of the drudgery reduction in local market for farm women.

Extent of adoption of drudgery reduction tools by farm women

Adoption of selected drudgery reduction tools for agriculture and allied sectors by the respondents were measured after one year of intervention. After measuring the knowledge and awareness on drudgery reduction tools way of procurement of selected technologies were analyzed in Table 5.

Table 5: Adoption of drudgery reduction tools after one year of interventions.

Sl. No.	Drudgery reduction tools	Way of procurement		From KVKs	Govt organization	Any other, (NGOs, etc)
		Individual	Group			
1	Improved sickle	65	0	35	0	0
2	Maize sheller (Tubular)	55	0	30	0	0
3	Maize sheller (Rotatory-type)	25	0	35	0	0
4	Fruit Harvester	0	0	51	0	0
5	Lemon harvester	0	0	15	0	0
6	Wheel hoe	67	33	0	0	0
7	Rake weeder	55	16	10	0	0
8	Ring cutter	0	0	25	0	0
9	Improvised paddy storage structure	0	0	26	0	0
10	Grain spreading tool	52	15	33	0	0
11	Paddy stripper	20	0	30	0	0
12	Ergonomically design weaving chair (Fly-Shuttle loom)	0	0	8	0	0

Perusal of Table 5 reveals that most of the drudgery reduction tools were introduced by Krishi Vigyan Kendra's (KVK) to farm women free of cost under OFT, FLD and APART programme like fruit harvester, lemon harvester, ring cutter, improvised paddy storage structure, ergonomically design weaving chair. Most of the drudgery reduction tools were purchased individually and from KVKs like improved sickle, hand maize sheller. Some of the drudgery reduction tools were purchased in groups like wheel hoe, rake weeder, etc.

Feedback from Farmwomen on Adoption behavior on different drudgery reduction tools

The response of the farm women regarding use of these technologies was recorded on three-point continuums which are always, sometimes and never. Adoption behavior, extent of use of selected technologies and adoption index for each of the technologies by the respondents were presented as below:

Table 6: Adoption behavior and extent of use of selected drudgery reduction technologies related to agriculture and allied science by the farm women:

Sl. No	Technologies	Adoption behavior %			Extent of use %		
		Adoption (f/%)	Discontinuance (f/%)	Non adoption (f/%)	Always (f/%)	Sometimes (f/%)	Never (f/%)
1	Improved sickle	85	15	0	80	20	0
2	Maize sheller (Tubular)	65	10	25	35	45	20
3	Maize sheller (Rotatory-type)	76	14	10	55	45	0
4	Fruit Harvester	66	24	10	55	35	10
5	Lemon harvester	47	19	34	47	38	15
6	Wheel hoe	77	20	3	57	31	12
7	Rake weeder	57	34	9	59	35	6
8	Ring cutter	42	14	44	32	46	22
9	Improvised paddy storage structure	78	10	12	80	20	0
10	Improved Grain spreading tool	56	21	23	78	20	2
11	Paddy stripper	45	21	34	32	20	48
12	Ergonomically design weaving chair	56	32	12	32	50	18

Data on Table 6 reveals different adoption behavior and extent of use of selected technologies by farm women which were as follows:

Improved Sickle

Improved sickle was always used for harvesting of crop to the extent of 80 per cent which was due to the reason that the farm women found it easy to use as the blades are serrated and easy to use, output was more, save time and labor and reduced health hazards in comparison with traditional sickle. Chetia *et al*., (2018) [7] also stated that women were highly satisfied with use of improved sickle. In this same context, Sanoj Kumar *et al*., (2019) [6] reveals in his study that due to light weight of improved sickle i.e., about 260g the fatigue causing on the wrist is less and the drudgery involved was reduced as compared to local sickle weight 350g. He also emphasized that use of improved sickle, frequency of postural change and angle of deviation at cervical region was reduced.

Maize sheller (Tubular)

Tubular maize sheller is a manually operated simple device which is octagonal in shape and consist of 4(four) fine steel fins tapered along their length and in each fin two holes were provided for riveting. Shelling maize to remove the grains from the cob has been a time consuming, tedious, creates pain and swelling in hand and wrist if shelling is done with hand stated by most of the respondents and hence tabular maize sheller was a good option for small scale farmers. In this context, Sanoj *et al*., (2019) [6] also stated that Tubular maize sheller can save time up to 44-45%. Extent of use of maize sheller was always used by farm women was 35% and 45% were used it occasionally. This is because more improved version of maize sheller were available than tubular maize sheller. However, tubular maize sheller was found far better than shelling of maize grain from cob with hand. It was found that the working capacity of tubular maize Sheller is 8-12 kg per hour.

Maize Sheller (Rotatory Type)

Rotatory maize sheller is used to separate grains from maize cob after manual de-husking of maize cob. With a view to improving labor productivity, reducing the tedium of work and minimizing finger soreness, a number of hand-held devices have been developed. The hourly output of shelled grain achieved by these devices was ranges from 10 kg to 20 kg per hour. It was found that rotatory hand maize sheller with a handle (Figure 3) is better than tubular maize sheller as it minimizes wrist soreness and more working efficiency. More than half of the farm women (55%) always use rotatory maize sheller and 45% use it sometimes. Many farm women also mentioned that they now use motorized, sophisticated and improved maize shelling machine which were brought from custom hiring center by a group of maize cultivator with a minimum hiring charge for shelling of maize.

Fruit Harvester

Fruit harvester with elevated blade is designed for better visibility with plastic rope net to hold more numbers of fruits (Figure 4). Khatri *et al*., 2021 [18] stated that traditional harvesting and post harvesting techniques are responsible for detoriating the fruit quality and shortening the post-harvest shelf life and therefore manual hand fruit harvester with elevated blade, net and pole is suitable for small scale fruit growers as it causes less damage to fruits and does not affect market quality of fruit. The adoption percentage of fruit harvester is quite high i.e., 66% and it cause negligible damage to fruit. It was found suitable to harvest fruits like carambola, guava, mango, sapota etc. as hand picking by climbing tree, tree shaking and stick biting is responsible to degrade quality of food and affect marketability. However, it was also observed that it can efficiently be use to harvest fruit like pomelo etc., if the circumference of fruit harvester is slightly bigger.

Lemon Harvester

The arduous operation of harvesting of lemon is usually performed manually with use of traditional hand tools in upright posture which creates back pain for majority of labors. Moreover, in traditional method of harvesting, fruits get damage and thus decrease its shelf life. Further, the thorns in Assam lemon tree hurt the farm women. Hence, the lemon harvester designed by AAU, Jorhat (Figure- 5) observed to be farmers friendly lemon harvesting tool as 47% of farm women always use it and 38% were use it sometimes. In this same context, Kankal, Uddhao (2014) [9] stated that average output of the harvester was found to 2.61 kg/ hour, the average work pulse value was found to be 38 beats per min. The average oxygen consumption was found to be 0.46 lit/min. Overall discomfort rating was observed as 2.5.

Wheel Hoe

The wheel hoe is a light weight, versatile and manoeuvrable push tool which is ergonomically designed and gives user more leverage than traditional hand hoe (Figure- 6). Adoption percentage of wheel hoe was found quite higher as 77% and

farm women always use wheel hoe (57%) during weeding and intercultural in row crop.

Rake weeder

Rake weeder (Figure 7) has a hard tines drudgery reduction tool attached with a long handle and used to remove shallow rooted weeds, scooping, scraping, gathering, or leveling materials, such as soil, mulch, or leaves. More than half of the farm women use rack weeder and adoption percentage was also found as 57%. Few farm women were found using homemade bamboo rake without any ergonomic measurements.

Ring Cutter

Conventional method of manual plucking without any aid can cause drudgery, discomfort and itchiness to skin as the texture of bhindi or brinjal plants are rough. Sanoj *et al*., (2019) [6] also that *Bhindi* plucker or ring cutter (Figure 8) can save time and labor and cutting efficiency of ring cutter was 3.75-4kg per hour. Adoption percentage of ring cutter was found as 42 and less than 46% of farm women use ring cutter sometimes for harvesting *Bhindi* (Okra) and Brinjal. 22% of farm women stated that the ring cutter was not properly fit in their finger and thus they feel uncomfortable with it.

Improvised paddy storage structure

Improvised paddy storage structure (Figure 9) is a big basket like container smeared with a mixture of cow-dung and mud and used to store paddy grains, mustard etc. The stored container is much bigger in its size with wide circumference opening at top and slightly tapered at bottom. It is approximately 5- 6.5 feet in height and kept it above the ground level with the help of a brick or cement pole of 1.5 feet high. Therefore, it was uncomfortable for farm women to draw grains from this stored structure and induced drudgery. Hence a metal drawing cabinet is attached below the storage container to take off grains comfortably, with ease and thus reduce drudgery. A metal lid was also attached in metal cabinet to close the chamber when not in use. Adoption % of this stored structure is 78% and was always used by 80% of women.

Improved Grain spreading tool

Improved grain spreading tool (Figure 10) has a bamboo handle (150cm length, circumference 100 mm) and a wooden blade (length 40 cm x breath 21cm) developed by AAU, Jorhat, Assam in 2002. It is ergonomically designed and manually operated hand tool used to reduce moisture content of paddy by spreading the grains under the sun.78% percent of farm women use it always to dry paddy before storage. However, it was also observed that some (23%) farm women self-designed the grain spreading tool of their own without following ergonomic principles and hence, adoption percentage was measured as 56%.

Paddy stripper

Paddy stripper (Figure 11) is used for paddy seed selection. The ergonomically designed paddy striper is designed in 2015 by AAU, Jorhat. The total length of the stripper is 30cm, circumference of the handle is 8.5 cm and length of the spikes is 16.5 cm. The adoption percentage is 45% but extent of use was found low (32% always and 20% sometimes) as spikes of the stripper were broken stated by 48% of farm women. Replacement of paddy stripper with some other light material rather than bamboo may increase its shelf life stated by many farmwomen.

Ergonomically design weaving chair:

Women usually sit on a plank of wood or in a bench while weaving and some use simple wooden chair which give rise to back and waist pain. Improper poster aggravates Spondylitis problem or neck pain too. Hence, Assam Agricultural University, Jorhat, 2011 designed ergonomically designed weaving chair for fly shuttle weaver with an attached drawer to keep all weaving spools, bobbins and accessories and thus reduce time and energy. Back rest provided in the chair reduce physiological fatigue and back pain. The adoption percentage is 56% and 32% always using it. Few weavers stated the chair height and loom height was mismatched as they already fixed their loom height as per weaver's anthropometric measurement. Further, it was found slight costlier as it was made up of wood stated by most of the weavers. The drawer sometimes struck in the chairs side panel hence metal stripe with lubricant or wheel may ease in drawing the drawer. However, commercially availability of ergonomically design chair rather than locally made may solve all problems stated by most of the weavers.

Fig 1: Improved sickle

Women harvesting cereal crops (paddy)

Fig 2: Maize sheller (Tubular)

Women shelling grains from maize cob with tubular hand maize sheller

Fig 3: Maize sheller (Rotatory type)

Women shelling grains from maize cob with rotatory hand maize sheller

Fig 4: Fruit Harvester

Women harvesting fruits

Figure 5. Lemon harvester

Women harvesting lemon from lemon tree

Fig 6: Wheel hoe

Women doing weeding and inter-culture operation

Fig 7: Rake weeder

Women doing weeding and shallow ploughing of ground

Fig 8: Ring cutter

Women harvesting Brinjal with ring cutter

Fig 9: Improvised paddy storage structure

Women easily draw grains from paddy storage device easily.

Fig 10: Grain spreading tool

Women spreading grains in floor with less drudgery

Fig 11: Paddy stripper

Women use paddy striper for paddy seed selection

Fig 12: Ergonomically design weaving chair (Fly Shuttle loom)

Women weaves in Fly shuttle loom and sit comfortably in ergonomically designed weaving chair

Conclusion

From the findings it can be concluded that majority of the agricultural and allied activities were perceived as difficult to perform by the farm women. Intervention programmes on drudgery reduction technologies for farm women conducted by different Krishi Vigyan Kendras of Assam were found to be effective which is indicative from the knowledge and adoption level of the farmwomen on technologies. Majority of the respondents were satisfied with the technologies and showed interest in adoption. A few of the respondents also pointed out some minor modifications in the technologies with which they can perform the activities more efficiently and with lesser use of effort and time. Drudgery reducing tools and equipment are proved to be a boon for farm women. Therefore, technological empowerment of women is utmost necessary to mitigate drudgery and ensuring better occupational health of the farm women.

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