Report on Survey of Post-harvest Technology and Constraints Faced by Women Farmers related to Small Millets and Associated Crops

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Location of Study

India, Sri Lanka and Nepal

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Revalorising Small Millets in Rainfed Regions of South Asia Project

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Contents

Acronyms

CIDA	Canadian International Development Agency
DHAN	Development of Humane Action
FGD	Focus Group Discussion
IDRC	International Development Research Centre
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
RESMISA	Revalorizing Small Millets in Rainfed Regions of South Asia
SMACs	Small Millets and Associated Crops
VDC	Village Development Committee

Acknowledgement

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Executive summary

Food and nutritional security is an important issue for the developing and underdeveloped countries. Small millets can be miracle crops, which can address both of the issues and can bring health, wealth and happiness to their producers. Small millets have many advantages like less water and external input requirement, ability to tolerate changing or unfavourable climate, capacity to grow in poor soil and environmental conditions and long storability of grains. Despite these properties, millets are going out of cultivation due to socio-cultural neglect and lack of promotional efforts. One of the major reasons for such a situation is difficult post-harvest operations in small millets.

The research project, "Revalorising Small Millets in Rainfed Regions of South Asia", aims to bring back these crops and one of the major objectives is to reduce the post-harvest drudgery, especially that of women. In this context, profiling of the existing post-harvest operations in the research locations was a pre-requisite to plan further research activities, to validate and streamline the already proposed activities. Hence a survey was conducted in all the research sites titled - "Survey of Post-harvest Technologies and Constraints Faced by Women Farmers related to Small Millets and Associated Crops". It was conducted with the purpose of 1) understanding existing post-harvest practices, 2) identifying problems and constraints in post-harvest processes, especially for women, 3) enlist best indigenous practices, if any and 4) to identify leads for research. Participatory methodology was followed and the methods used are FGDs, key informant interviews, interviewing secondary stake holders and photo documentation. This is a consolidated report of the studies carried out by the South Asian partner organizations in all the project locations.

Labour intensiveness of post-harvest processes of the small millets was common across the research locations and women primarily bear this burden. The labour intensiveness becomes an additional problem in the context of inadequate availability of labour and increasing labour costs. Traditional dehusking process of many of the small millets is tedious and time consuming. It was one of the important reasons for drastic reduction of consumption of little millet in Jawadhu Hills. Continuous rains and cloud weather during post-harvest period was an important constraint faced by the communities across the sites. Blackening of finger millet grains, lodging of plants, shattering of grains and difficulty in separation of grains from panicles were reported. Besides these, some health problems like wounds in hands and feet during threshing and itching and respiratory problems during winnowing were reported in Nepal site. While presence of flour mills for finger millet was reported in most of the sites, very limited presence of mechanical dehullers were reported. Even if the dehullers were present, their performance in terms of quality of dehulling and conversion ratio of rice from grains was found very much wanting. While storage pests were less of a problem with small millets, it was a major problem in associated crops, particularly pulses. Finding of the study indicated that any research on improving post-harvest handling processes need to have inbuilt perspective of gender concerns, as most of the tedious works were undertaken by women. Evolving specific leads for research emerging from the above mentioned issues was also attempted in this report.

Survey of Post-harvest Technology and Constraints Faced by Women related to Small millets and associated crops

1. Introduction

Among the major global issues, food and nutrition security, especially in developing and under developed countries are the biggest challenges of the present agricultural scenario. While the policy decisions to increase food production through modern agricultural movements like "green revolution" have been successful in some well endowed areas, they have not benefited those countries and regions which have major area under rainfed agriculture. Analysis of the crisis reveals that modern agriculture laid over-emphasis on a few major crops like wheat, rice, maize, leading to continuous decline in crop diversity on cultivated lands. Most of the crops like millets, pulses and oilseeds, which are grown largely under rainfed situations, were marginalized and efforts on research and development activities in rainfed farming were comparably insignificant. Several studies have indicated that the millets and their associated crops like pulses and oil seeds, which formed staple food grains of the farming community in the past, are highly nutritious and are most suited to semi-arid regions.

Realizing the significance of small millets to enhance the food and nutritional security of the people, a consortium of partners in India, Sri Lanka, Nepal and Canada is jointly working on an IDRC/CIDA funded initiative 'Revalorizing Small Millets in Rainfed Regions of South Asia' (RESMISA). The two major objectives of the project are a) To increase area under production and productivity and b) To transform the increased production into increased consumption. For realizing the second objective, one of the major interventions envisaged in the project is to overcome the difficulties associated with post-harvest operations of small millets and their associated crops. Being marginalized crops in terms of scientific research and socio-cultural values, not much scientific investigations have taken place either to evaluate the traditional practices or to develop new methods to deal with the post-harvest problems, especially processing of small millets. Further it is important to understand the site specific situation and the needs of the community related to post-harvest. So this survey on post-harvest technology (PHT) and constraints faced by women farmers was under taken in all the project sites as part of the project, with the following objectives:

- To study the existing post-harvest handling practices followed in small millets and their associated crops
- To identify the problems and constraints faced by the farmers, especially women, during various stages of post-harvest handling of focused crops
- To enlist the best indigenous practice/knowledge, if any, related to harvesting, threshing, processing and storage in a particular crop across the sites
- To identify the areas of research to address the issues of PHT of small millets and associated crops

2. Methodology and methods

A participatory methodology was followed with community at the centre, to elicit information about post-harvest processes followed in the research locations. The following four methods were followed for the survey of post-harvest technologies and constraints faced by women:

1. Key informants interview- Interview of well informed and experienced farmers was taken up for getting in-depth understanding of various post-harvest technologies and the constraints faced by the community and for observing tools and structures involved. Key informants were selected across the villages to understand the variations across the villages in the site. Efforts were taken to ensure fair share of women among the key informants. An interview schedule was prepared for this purpose and used across the sites (See Annexure 1)
2. Focus Group Discussion (FGD) - FGD was conducted for capturing the collective understanding on PHT and constraints faced by the community and to capture variations across the families. FGDs were conducted across the villages to understand the variations across the villages in the site. Separate FGDs were conducted for men and women for understanding the difference between the genders on perceptions of post-harvest processes followed. In Nepal pair wise ranking was used separately with men group and women group to prioritize the issues related to post-harvest.
3. Interview of other stakeholders: Interview was conducted with other stakeholders like mill owners and product manufacturers in the local area based on availability, to understand their perspective on post-harvest processes.
4. Photo documentation

2.1 Number of FGD and key informants

The number of villages, number of FGD and number of key informants for household survey varied from site to site (Table 1). In Nepal, the key informants were identified during FGD, based on their years of experience in growing millets.

2.2 Data entry and analysis

After completion of FGDs and household level interviews, quantitative data obtained were compiled in Microsoft Excel sheet and analyzed.

2.3 Report preparation

While individual site team collected data and prepared the site specific report for Nepal, Sri Lanka, Semiliguda, Bero and Dumbriguda sites, Tamil Nadu Agricultural University did the study in collaboration with DHAN Foundation in Anchetty, Jawadhu Hills and Peraiyur. The current report is prepared by DHAN Foundation by compiling the site specific reports, with the focus of comparative analysis of PHT and constraints faced by women related to small millets across the

sites to get an overall picture and to link the findings of the survey with the research objectives and activities of the RESMISA project.

Table 1 Number of key informants and FGDs in different project sites

Country	Project sites	Number of villages	Number of key informants			No of FGDs
			Male	Women	Total	
Nepal	Dhikurpokhari VDC, Kaski district	3	2	2	4	1
	Kaskikot VDC, Kaski district		2	2	4	1
	Jogimara VDC, Dhading district		2	3	5	1
India	Peraiyur, Madurai district	10	24	26	50	5 Men groups + 5 Women groups
	Jawadhu Hills, Tiruvannamalai district	6	9	21	30	2 Men groups + 3 Women groups
	Anchetty, Krishnagiri district	6	17	13	30	3 Men groups + 2 Women groups
	Semiliguda, Koraput district	8	6	7	13	
	Dumbriguda, Visakapatnam district	3	9	6	15	1 with mixed group
	Bero, Ranchi district	6	3	2	5	1 Men group and 1 Mixed group
Sri Lanka	Thanamalwila, Monaregala district	3	20	20	40	

3. Findings

The study was restricted to the important small millet crops and their associated crops (SMAC) in each project sites. The focus crops identified in each project sites are listed in Table 2. Finger millet is the focus crop in seven sites located in Nepal, India and Sri Lanka. Little millet is the main crop in Jawadhu Hills while it is also grown largely in Semiliguda and Dumbriguda sites in addition to finger millet. Barnyard millet and Kodo millet are grown only at Peraiyur site. The results of the survey from each of the project sites were compiled cropwise and presented in the following sections.

Table 2 Focus crops in different sites

Sr. No.	Project sites	Small millet crops	Associated crops	Cropping pattern
1	Nepal			
	Dhikurpokhari VDC	Finger millet	--	As relay crop in maize
	Kaskikot VDC	Finger millet	--	As relay crop in maize
	Jogimara VDC	Finger millet	Horsegram, Rice bean	As relay crop in maize, sole crop
2	Peraiyur	Barnyard millet, Kodo millet	Field Bean	Sole and mixed crop
3	Jawadhu Hills	Little millet, Finger millet	Horsegram, Niger	Sole and mixed crop
4	Anchetty	Finger millet	Horsegram, Field bean	Sole and mixed crop
5	Semiliguda	Finger millet Little millet	Horsegram, Niger	Sole crop
6	Dumbriguda	Finger millet Little millet	Horsegram, Niger	Sole crop
7	Bero	Finger millet	Horsegram, Linseed	Sole and mixed crop
8	Thanamalwila, Sri Lanka	Finger millet	Cowpea	Sole crop

3.1 Finger millet:

Harvesting (includes harvesting, transporting, staking and drying)

The harvesting of finger millet crop takes place mainly during October to November in India and Nepal, while the cropping season for the crop is different in Sri Lanka (Table 3). There are two methods of harvesting followed across the sites.

1. Harvesting of only panicles - After crop maturity, the matured panicles (ear heads) are collected by cutting with the help of sickle leaving the plant stalks as such in the field; the operation is being carried out at one time or at intervals depending on the uniformity of maturity. The harvested panicles are gathered in a container, such as bamboo baskets (*tokri)* at Bero, before heaping them in a convenient place. The panicles staked in heaps are left for sun drying for a period ranging from one week to more than a month. Some of the farmers believe that the heat generated within the heap will help in easy separation of grains while threshing. In Nepal, while this practice of softening of finger is there, it is observed that if this period of softening exceeds 15 days it results in deterioration of quality of grains. While at Bero site the panicles are displaced frequently within the heap using an iron raking tool with long wooden handle for better aeration, at Sri Lanka the panicles are spread on the floor for sun drying for two to three days and then stored in sacs before threshing.

In some sites like Thanamalwila, Sri Lanka, the uncut stalks are left in the field for grazing by the domestic animals and later the left out stables get incorporated in the soil during land preparation. In Nepal and Jawadhu Hills the stalks are collected by cutting them at base and stored for using as fodder, which means doing cutting operation twice, one for collecting panicles and another for stalks.

Table 3 Harvesting operation in finger millet at different project sites

Project sites	Time of harvesting	Harvesting methods	Transporting	Labor requirement /acre	
				Men	Women
Nepal site	Oct – Nov	Collecting ear-heads, staking in heap 1 week, cutting straw later	Ear-heads on head load	11	34
Anchetty	Oct – Nov	Straw with ear-heads, spreading in field for 2-4 days, staking for 1- 1 ½ months	Bundles of straw on head load	3	20-25
Semiliguda	Nov 2nd half	Straw with ear-heads, spreading in field for 10-12 days, staking upto 1 ½ months	Bundles of straw on head load	5	10
Dumbriguda	Nov – Dec	Straw with ear-heads, spreading in field for 2-3 days, staking upto 1 month	Bundles of straw on head load	4-6	6-8
Bero	Oct 2nd half	Ear-heads collected in tokri, staking in heap for a few days to one month	Ear-heads on head load	1	26
Jawadhu Hills	Oct	Ear-heads alone harvested, 2 days drying, staking for up to one week	Ear- heads on head load	3	10
Thanamalwila	Jan	Ear-heads collected at intervals, spread on the floor, sun dried 2-3 days, stored in sacks	Ear-heads on head load	NA	NA

Note: NA- Not available

2. Harvesting of stalks along with panicles – This is the most commonly followed method in the areas of large scale cultivation of finger millet, say like Anchetty. The harvested stalks are spread in rows in the field for sun drying, commonly for two to four days and may go up to 12 days depending on weather conditions. The harvested stalks are bundled and staked near the threshing yard. In case of rainy days farmers in Anchetty follow a staking practice called as *Sanai*, which involves arranging the bundles remaining in the field in closed lines in slanting position and covered with dried straw to prevent dampening. After 10-12 days the cover is removed and allowed to dry for one to two days before staking at the yard. Staking of bundled stalks is an art. It is usually done by arranging the bundled stalk in such a way that the panicles are covered inside the heap and rain water does not enter into the heap. So, such a staked

heap is kept for a period of one to one and half months before threshing. A special type of wooden structure, called *Bhadi* is used for staking stalk bundles near threshing yard, in Semiliguda site. A wooden structure with four pillars and straw fixed above it is prepared. They arrange the bundles of finger millet properly on the frame and cover it with straw so that it will not be damaged by animals and rainfall, this is called as *Bhadi.*

Labor requirement for harvesting operation varies across the project sites. Though both men and women are involved in harvesting operations, it is more number of women labor who carry out most of the activities. Because of very different method of harvesting (harvesting panicles and stalk separately) followed in Nepal the labor requirement per unit area is comparatively high.

The major issues faced during harvesting and staking are:

1) Harvesting coinciding with heavy rains and lack of sunny days leading to problems like lodging, shattering of grains, blackening of grains and straw, increased duration of heaping before threshing resulting in deterioration of quality of grain and some times germination of seeds in the fields (due to continuous rains). Last year Anchetty farmers were severely affected by blackening of grains and straw. The consumption quality of grains has deteriorated, lower price was realized and they could not use their own produce as seed in the next year. Farmers belonging to Bedrahalli, Anchetty observed that the variety *Sharadha* did not shatter the grains due to heavy rainfall while other varieties in vogue had significant loss due to shattering of grains. Bero farmers observed that the curved fingered varieties (*Demba* – an introduced short duration high yielding variety) retained rain water in the heads and hence lodged, while the open fingered (*Gibra* – a traditional long duration variety) varieties did not retain water in the heads and hence did not lodge.

2) Labour shortage as majority of farmers do harvesting simultaneously. In Bero and Semiliguda, harvesting coincides with harvesting of paddy and hence it is prioritized over finger millet.

3) Non synchronous maturing of the panicles, may be due to use of mixture of different varieties (Nepal)

4) Labour requirement for harvesting operation is high and given the increase in wages, harvesting is becoming a costly activity.

Threshing (grain separation, winnowing, bagging and transport)

There is lot of variation across the sites related to threshing operation, as seen from table no. 4. The study indicated that different types of threshing yard are used across the project sites. Leveled mud floor smeared with cow dung slurry, home court yard, concrete yard, and public tar roads are commonly seen as the available threshing yards in finger millet growing sites.

Table 4 Threshing, winnowing, cleaning, drying and bagging of finger millet

Project sites	Threshing methods	Winnowing and cleaning	Drying and bagging	Labor requirement /acre	
				Men	Women
Nepal site	Hand pounding the panicles with stick in home court yard during day	Manually during windy hours: Bamboo equipments *nanglo* and *chalnu* used	Sun drying for 2-3 days	16	28
Anchetty	Use of stone roller (*kundu*) with a bullock pair in mud yard	Manually during windy hours, iron rakes and sieves for cleaning	Sun drying 1 day, nylon woven or gunny bags	12	12
Semiliguda	Trampling by bullocks, hand pounding partially threshed panicles with stick in mud yard	Manually during windy hours, cleaning with *chaluni*	Sun drying in home court yard		
Dumbriguda	Using cattle and/or hand pounding with stick in mud yard	Manually during windy hours, lit up fire to generate wind flow	Sun drying in home court yard	4-8	5-12
Bero	Using bullocks or tractor and hand pounding in mud yard/ tar road	Manually during windy hours	Sun drying in home court yard 1-2 days	2	6
Jawadhu Hills	Beating with stick upto 1 bag and trampling by bullocks for more volume	Manually during windy hours, *visu muram* used for cleaning	Sun Drying for one day	4	6
Thanamalwila	Hand pounding using mortar and pestle	Manual using special device, cleaning with device made up of clay	Sun drying in home court yard 3-4 hours	Only wom en	

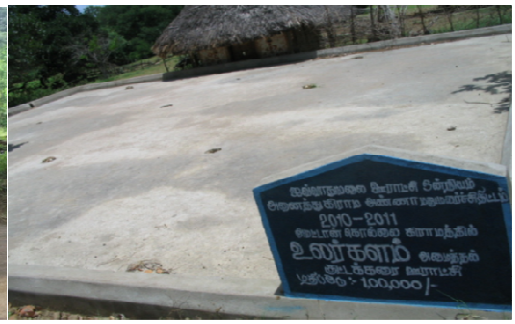
Separation of grains – Threshing methods for separating grains from the panicles are also varying (Table 4) based on the scale of cultivation and availability of infrastructure. Spreading of panicles or stalk with panicles is done early in the morning and threshing starts from 10 o'clock. Threshing of only panicles or stalks with panicles, especially when the quantity is large, is usually done by using bullocks (4-5 in number) for trampling or by stone roller drawn by a pair of bullocks. The stone roller is known as *kundu* in Anchetty site and its size is about 2 ½ feet in length and 2 feet in diameter (see picture 1 below). On tar roads, the vehicular movement

helps in separation of grains from the panicles. In place of bullocks tractor is also used by some farmers. In Nepal beating the heads with sticks in the home courtyard or trampling under feet by women is followed for threshing the panicles while mortar and pestle is used in Sri Lanka. Hand pounding is usually followed to thresh the small quantity of partially threshed panicles remained after cleaning the separated grains in other methods. It is observed in Anchetty that some farmers use paddy threshers for threshing finger millet, which need to be further explored for understanding it's benefits to the farmers.

Picture 2: Stone roller (Kundu) for threshing finger millet in Anchetty

Winnowing and cleaning – Winnowing is done manually during windy hours, usually in afternoon. Before winnowing the threshed bulk is cleaned from straw using iron rakes followed by first winnowing for cleaning from the straw pieces and dust. Sieves are used for cleaning straw pieces, stone particles and other materials and this operation is handled by two men. The un-husked grains are hand pounded and mixed with the bulk produce before final winnowing. In Nepal winnowing is done using bamboo made local equipments (*Nanglo, Chalnu*) are used. The cleaned grains are usually sun dried for one to two days before bagging.

Picture 2: Winnowing



Picture 3: Threshing yard

The threshing operation is completed in one day or it may get extended to the next day. Both men and women are involved equally in most of the sites but in Nepal more women are required and it is only women who do the threshing operation in Sri Lanka. In Dumbriguda site fire is lit to generate wind flow if there is not much natural wind flow. They also tie cloth to a tree to know the wind direction. In Bero farmers observed the *Gibra* variety was more easily threshed than the *Demba* variety.

In Sri Lankan site, since drying of finger millet panicles is done on the floor of famer's house, addition of sand is a serious problem. Once seeds are removed, sand is separated using a special device made of clay in the presence of water. Once sand is separated grains are again sun dried two to three hours. Cloudy weather is a problem for this operation. These operations are done by women.

Issues:

1) In Nepal it is observed that trampling by women results in rashes in the feet and beating with sticks results in swollen patches in the palm. Further winnowing results in itching and respiratory problems.

2) Labour requirement for threshing operation is high and given the increase in wages, threshing is becoming a costly activity.

3) Drying for two to three days is a pre-requisite for easy grain separation during threshing, but this may not be achieved due to weather conditions. In Nepal, the advent of winter season coincides with harvesting and so having adequate number of sunny days is an issue.

4) Low air during winnowing increases labour requirement to as much as 3 times of the labour requirement when there is good air.

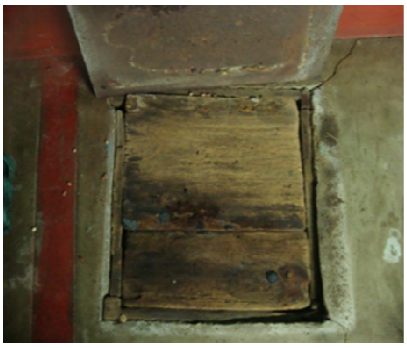
5) Threshing on roads leads to grain damage and loss. Threshing and drying on mud floor is less efficient than on cemented floor and access to cemented threshing yards is limited in the project sites.

6) Small stones, dirt and other varieties of finger millet get mixed with the grains during threshing and drying operation.

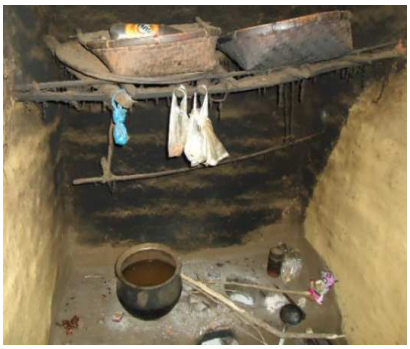
Storage of grains and seeds of Finger millet

Study revealed that farmers across the sites sun dry the grains as well as seeds before storage. Various structures are used for storage of grains and seeds. Usually closed structures are used for seeds. While gunny bags or nylon woven sacs are most commonly used in present days in many of the sites, majority of the farmers in Nepal store finger millet in bamboo structure known as *Bhakari* (Table 5). In Anchetty, an underground storage system by name *Kalanjiam* (see picture 4) was used earlier. It is made of wooden planks and it was told that grains stored in *Kalanjiam* will be in good condition even after 10 years. In Semiliguda the grains are stored above the stove in a bamboo structure to avoid moisture during rainy days. This structure is called locally as *turjhulla* (see picture 5). In Dumbriguda grains are stored in the attic (see picture 6). In Bero storage containers made of paddy straw, woven into a basket was used earlier, it was called as *poval chatka*, and this practice is no longer observed. Plastic bags are made into a big storage container by tying it together with sticks and this is called as *Chatka*. The storage period varied across the sites ranging from one year to a maximum of 5 years for grains and one year for seeds. It is observed by farmers from Nepal site that longer stored finger millet has poor taste.

Storage insect pests is not a serious problem, hence no special treatment is followed for storing the grains in most of the sites, but in Sri Lanka DDT powder is used to control insects by all the interviewed farmers. Some farmers also use *neem* and *tulsi* to repel insects. In Anchetty too chemical balls are used to keep out insect pest. Rodent damage is reported in Anchetty, Dumbriguda, Sri Lanka and Nepal and rodenticides or traps are used to address this issue.



Picture 4: Picture of *Kalanjium,* Anchetty



Picture 5: Picture of *Turjhulla,* Semiliguda

Picture 6: Grains stored in attic, Dumbriguda

Table 5 Storage methods for finger millet grains and seeds in project sites

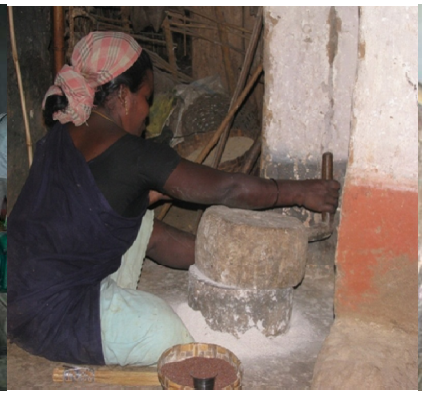
Project sites	Storage structures	Storage period	Remarks
Nepal site	*Bhakari*, clay pots, plastic drums, bamboo baskets, tins	1 ½ years for grains 11 months for seeds	Closed structures for seeds
Anchetty	Gunny bags, mud sall, clay pots, *dombai, kalanjiam*	Grains-Upto 3 years Seeds- 1 year	Structures varied depending on the quantity in earlier days
Semiliguda	Plastic bags, earthen pots	Grains and seeds 1 year	*Turjhulla* during rainy season
Dumbriguda	Gunny bags, earthen pots, bamboo baskets,sacs	Grains-2-3 years Seeds – 1 year	
Bero	Gunny bags, plastic bags, *chatka*	Grains upto 5 years Seeds 1 year	*Poval chatka*- a traditional practice
Jawadhu Hills	Gunny bags	Grains upto 2 years, seeds upto 1 year	*Dombai* – a traditional practice
Thanamalwila	Poly sacs, SS utensils, tins, plastic bins, clay pots	Grains and seeds 1 year	Chemicals, neem leaves, tulsi leaves used for seed storage

Processing of finger millet

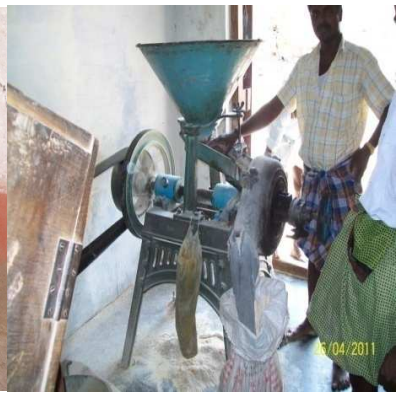
Grains need to be dried and cleaned to remove thin husk and small stone particles before processing. To do this type of cleaning manually is a tedious and more time consuming job, which earlier was done by the women. Now, cleaning machines – aspirator and destoner- are available for this purpose (see picture 7). But among the seven sites it is available only in Anchetty along with flour mill. In some other sites it is available as part of a rice and other grains processing unit. Flour is the only processed finger millet product made for home

consumption. Traditionally grains were hand processed into flour using stone grinder(see picture 8), called differently in local languages in different sites (*Janto* - Nepal*, Pathar jota* - Semiliguda*, Chakki* - Bero*, Kurakkan stone* – Sri Lanka, *Ariyakkal* - Anchetty). Presently grains are processed in flour mills which are usually accessible within a radius of 5 kilometers distance (see picture 9). In Nepal earlier water powered grinding mills were available; but now electricity based grinding mills are in use. There is a difference in opinion across the sites regarding the comparison of taste between flour made of grinding stone and flour made from mill. While Semiliguda and Bero farmers expressed reduction in taste of flour made from mill over that of grinding stone, farmers from Nepal felt the reverse. The difference can be explained by the difference in parameters observed by the communities involved. An interesting observation made by Nepal team is that when grinding was done at home, a tedious job, only women was involved and now both men and women are involved in grinding finger millet in the mills.

Picture 7: Destoner, Anchetty



Picture 8: Stone Grinder



Picture 9: Flour mill, Anchetty

Box 1: Finger millet grains processed at a time by Sri Lankan Families

In Sri Lankan site it was attempted to understand the amount of finger millet grains processed at a time by the families in the project villages. The study revealed that majority of the families process three to eight Kg at a time. This kind of observation helps in doing adaptive research on identifying suitable grinding mills specific to each site.

Amount processed (kg)	< 1	1	2	3-4	5	6	7	8
Percentage farmers	7	8	6	26	23	21	6	3

Leads for action research

1) Weather related issues like heavy rains and cloudy weather during harvest and threshing were observed in many of the sites. Identification of varieties that has ability to perform under these conditions like early maturing variety and variety with non lodging and less shattering characters and including the same in the participatory varietal selection in the sites can be helpful. The issue of blackening of grains due to continuous rains during harvest is taken up for

research under the project for understanding the pathogen involved and for finding ways to address this issue.

2) Labour requirement for harvest and post-harvest operations for finger millet seems to be relatively higher than other cereal crops when it is seen in the back ground of low productivity and low value. Given its value as a nutritious crop, labour efficient practices need to be evolved to address this issue. As observed by few partner research organizations appropriate thresher can be a valid research agenda. More exploration across the sites for exchange of best practices that can increase labour efficiency can be another approach. Pursuing this research agenda can have significant benefits to women, who bear the major burden of post-harvest handling activities.

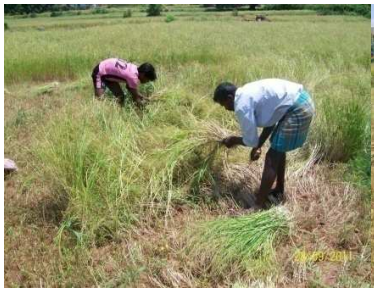
3) Introduction of small scale aspirators and de-stoners to other sites as in Anchetty has the potential to improve the hygiene and there by the quality of finger millet flour. Further exploration in this direction is needed to understand the site requirements and need for such an adaptive research.

4) Any research agenda in PHT of finger millet need to be sensitive about the consequences related to gender aspects, as women are the key players in the post-harvest processes.

3.2 Little millet

Post- harvest handling of little millet was studied in three project sites, namely Jawadhu Hills, Semiliguda and Dumbriguda. Harvesting period for the short duration varieties is from September end to October and January for long duration varieties.

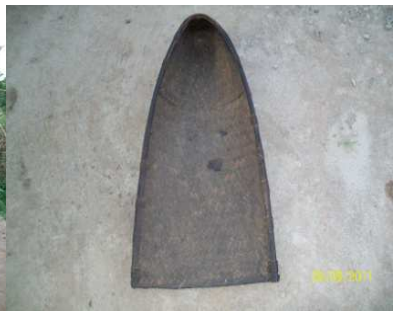
Harvesting– The short duration little millet is harvested manually using sickle to cut the stalks along with panicles. The stalks are spread in rows on the field for sun drying. After 5 days the stalks are bundled and staked near the threshing yard for a period of one month. Long duration varieties are harvested for panicles only. Last year mechanical harvesting of little millet was tried at Jawadhu hills with minor alterations in paddy combine harvester, but the results was not welcome among farmers. The loss of grains and the straw was considerable. Further this technology is not suitable for small holdings with undulated land. Continuous rains during harvest were expressed as main problem in Jawadhu hills and Dumbriguda. Sometimes the seeds germinate when they are in the field itself. Grain shedding is very common if there is delay in harvesting. At Semiliguda the stack is covered with bamboo structure, called *Dola*, for protection from rain. Harvesting and staking requires about 2 men and 3 women for one acre area.




Picture 10: Harvesting at Jawadhu Hills Picture 11: Harvested crop lay in field

Threshing- The bundled stalks are spread in the threshing yard, mud or tar road, and threshed using cattle (see picture 12) or hand pounding with stick. Winnowing is done using shallow bamboo baskets, called *muram. Visu muram* (see picture 13 &14) is used for blowing the wind like a hand fan. Again continuous rains are major problems faced by the community. The problems involved are wet threshing yards and difficulty in separating grain from the panicle. Mixing of soil with grains also reduces the quality of the grains. The cleaned grains are sun dried for 1-2 days before storing. The threshing operation requires about 9 laborers including both men and women. Farmers in Dumbriguda dry small quantities in bamboo sheets placed above the cooking fire in kitchen. Poly sheets are used for drying grains when the drying yard is wet.

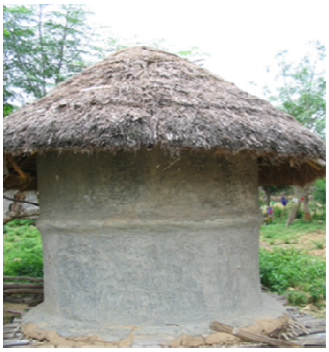




Picture: 12: Threshing by bullock Picture 13: *Visu muram* in use Picture 14: *Visu muram* – Close up

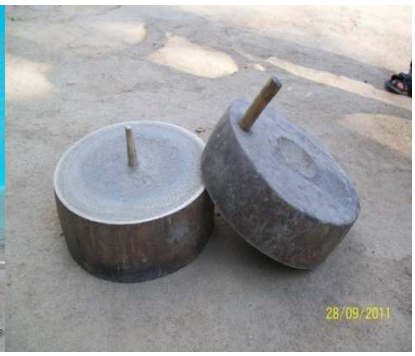
Storage and processing – At Jawadhu Hills the grains are sold over a period of time based on need for cash and market price. It was observed that majority of the farmers keep their produce more than a year and there are farmers who have more than 10 years old stock. Plastic bags, sacs, clay pots, bamboo baskets (*Duddi*) are used for storage of grains. *Khersi*, a special type of storage structure made of mud, reinforced with bamboo and covered with Palmyra leaves is used at Semiliguda site. Dehusking of little millet is usually carried out by hand pounding, using either wooden mortar and pestle or wooden dehusker or both. Stone grinder is used for making flour. It was observed by Jawadhu hills farmers that using wooden dehusker is easier than wooden mortar and pestle. In Dumbriguda dehusking is done at once in 10 to 15 days; but in Jawadhu hills the frequency is less. In Dumbriguda for dehusking they start with hand pounding with pestle and mortar, followed by sun drying, which is followed by dehusking with wooden de-husker. The community perceived that it is a difficult task and the new generation is not interested in doing this difficult task. This difficulty could be one of the

important reasons for fast decline in consumption of little millet. The community also shared that a mill was set up in Jamunamarathur long back. It did not run for long as people did not prefer the taste of the milled little millet rice and it was said that the rice made out of milled little millet becomes pasty while the hand pound retains its shape as rice when cooked.



Picture 15: *Khesri*, storage structure

Picture 16: Pestle and mortar



Picture 17: Wooden grinder

Leads for action research

1) Weather related issues like heavy rains and cloudy weather during harvest and threshing were observed in many of the sites for little millet also. Identification of varieties that has ability to perform under these conditions like early maturing variety and variety with non lodging and less shattering characters and including the same in the participatory varietal selection in the sites can be helpful.

2) Pursuing research for improvising existing paddy harvester to suit for little millet harvesting can be one of the research agenda.

3) From the food security perspective developing / refining a dehulling machine that is appropriate and functional in terms of meeting the requirements at the research site and dissemination of the same is an important research agenda. Care should be taken to develop prototypes that ensure minimum loss of nutrients in the dehusking process. From the gender perspective also this research agenda is an appropriate one.

3.3 Barnyard millet and Kodo millet

Barnyard millet and Kodo millet are extensively grown at Peraiyur site. In the case of barnyard millet the panicles are harvested after the crop maturity. About 10-15 women laborers needed to harvest one acre of land. Harvested panicles are transported to the threshing yard as head load or using tractor by the men lobourers. The panicles are kept as such in gunny bags for 1-4 days before threshing. Farmers feel that it helps for easy separation of grains.

Kodo millet is harvested by cutting the stalks along with the panicles which are spread in the field for sun drying for 1-2 days. The operation is known locally as *avial* or *ambal.* For harvesting one acre 8-12 lobourers are required. Transporting is done same as for barnyard millet. Both the millets are threshed using public tar road as threshing yards. Labor required is 3-4 women and 2 men for barnyard millet, while 5-6 women and 2 men for kodo millet. Some farmers also use tractor and complete the operation within 45-60 minutes.

Selected panicles are threshed separately for seed purpose. For both barnyard and kodo millet rainfall during harvest is considered as a major problem as it results in lodging of plants, shattering of grains and discolouration of grains.

The cleaned grains of barnyard or kodo millet are usually sold at the yard itself by most of the farmers. Other farmers, having storage facility, may store the grains in gunny bags for a maximum period of one month. The seeds are stored in gunny bags without any treatment or castor seed powder may be mixed with barnyard millet seeds to prevent pest infestation. Usually seeds are sun dried 2-3 times during storage period of 9-10 months. In some villages drying is done on new moon day, as the community believes that there will be less pest attack.

Picture 18: Storage in gunny and cloth bags

Picture 19: Earthen storage pot

Picture 20: Grains stored inside earthen pot

Traditionally kodo millet used to be processed in *Thirugai,* a stone grinder specifically converted for the purpose. Farmers believe that kodo millet has seven layers of husk and so the most difficult grain for dehusking. The grinding surface of the stone grinder is made soft by attaching a gunny bag cloth to the lower surface and a strong cotton cloth (locally called *gada* cloth) to the upper surface of the stone grinder by pasting it with wet clay. Barnyard is traditionally dehusked using pestle and mortar for rice purpose and dehusked using stone grinded for gruel purpose.

Processing mills are available at the site in Athipatti and M. Kallupatti villages. These are abrasive type emery roller mills, in which emery stones of larger gradient size are embedded on rollers. The above sited mills are multi purpose mills of bigger capacity and suitable for pulses

and small millets. Two passes are required for barn yard millet and three for kodo millet. Time taken to process is 1 hour/qtl for barnyard millet while it is 3 hours/qtl for kodo millet. Conversion ratio is 40 to 50 percent for kodo millet and 60 percent for barnyard millet. There is also facility in the same mills to make flour from the processed millet rice. It was informed by the women informants that bran is lost while dehusking in those mills and not so when done manually. The colour of the kodo millet in hand processing would be yellow while that of mills is white. The rice and flour are stored in gunny bags or plastic container or aluminum vessels upto one month.

Kodo millet poisoning is a major issue related to loss of quality of food grains. Further exploration is required to understand the extent of the issue in the site. Research is taken up under the project for understanding the pathogen involved and for finding ways to address kodo poisoning.

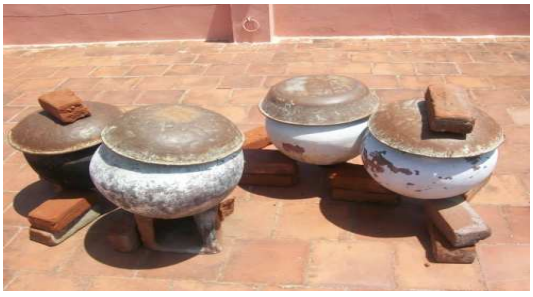
Picture 21: Processing of kodo milet

Picture 22: Three hole stone grinder

Picture 23: Stone mortar

3.4 Associated crops of Small millets

The main associated crops of small millets in the sites are horse gram, rice bean, field bean, linseed and niger. However, the farmers in the project sites do grow other minor pulse crops, but in smaller scale. These crops, whether as sole crop or mixed, are harvested by collecting the whole plant or by collecting only the pods. Threshing to separate the grains is usually by hand pounding with stick. After winnowing and cleaning, the grains are sun dried before storing. Since insect pests are serious problem during storage of pulses different storage methods are followed. Clay pots, tins, plastic containers, plastic sacs are the common structures used for storing the grains. Mixing of castor kernel powder, filling top 1/3rd to half portion of earthen pot above the seeds with sand, placing the storage container of pulses at the center of millet grains stored in big structures, sun drying at frequent intervals are some of the procedures followed across the project sites for storing the grains without infestation.



Picture 24: Storage of associated crops on terrace

4. Major constraints in post-harvest handling of small millets and associated crops

During the study it was possible to enlist a number of constraints related to post-harvest handling of the focused crops. A few of them are common across the project sites while others are specific to particular sites.

- Harvesting coinciding with heavy rains and lack of sunny days leading to problems like lodging, shattering of grains, blackening of grains and straw, increased duration of heaping before threshing resulting in deterioration of quality of grain and some times germination of seeds in the fields (due to continuous rains).
- Drying for two to three days is a pre-requisite for easy grain separation during threshing, but this may not be achieved due to weather conditions.
- Low air during winnowing increases labour requirement to as much as 3 times of the labour requirement when there is good air.
- Labour shortage as majority of farmers do harvesting simultaneously. In Bero and Semiliguda, harvesting coincides with harvesting of paddy and hence it is prioritized over finger millet.
- Labour requirement for harvesting and threshing operations is high and given the increase in wages, harvesting is becoming a costly activity.
- In Nepal it is observed that trampling by women results in rashes in the feet and beating with sticks results in swollen patches in the palm. Further winnowing results in itching and respiratory problems.
- Threshing on roads leads to grain damage and loss. Threshing and drying on mud floor is less efficient than on cemented floor and access to cemented threshing yards is limited in the project sites.
- Small stones, dirt and other varieties of finger millet get mixed with the grains during threshing and drying operation, thereby leading to loss in quality.
- Rodent damage is a significant problem in some of the sites for small millets and insect pests are a major problem with the associated crops.
- Lack of adequate processing facility for all small millets except finger millet.
- Dehusking is a tedious and time consuming operation undertaken by the women and an important reason for reduction of consumption

5. Leads for research

1) Weather related issues like heavy rains and cloudy weather during harvest and threshing were observed in many of the sites. The research leads are:

    - Identification of varieties that has ability to perform under these conditions like early maturing variety and variety with non-lodging and less shattering characters and including the same in the participatory varietal selection in the sites can be helpful.

    - Research on the issue of blackening of finger millet grains due to continuous rains during harvest for understanding the pathogen involved and for finding ways to address this issue.

    - Similarly research on the issue of kodo millet poisoning for understanding the pathogen involved and for finding ways to address this issue.

2) Labour requirement for harvest and post-harvest operations for finger millet seems to be relatively higher than other cereal crops when it is seen in the back ground of low productivity and low value. Given its value as a nutritious crop, labour efficient practices need to be evolved to address this issue. As observed by few partner research organizations appropriate thresher can be a valid research agenda. More exploration across the sites for exchange of best practices that can increase labour efficiency can be another approach. Pursuing this research agenda can have significant benefits to women, who bear the major burden of post-harvest handling activities.

3) Introduction of small scale aspirators and de-stoners to other sites as in Anchetty has the potential to improve the hygiene and there by the quality small millet products. Further exploration in this direction is needed to understand the site requirements and need for such an adaptive research.

4) Any research agenda in PHT of finger millet need to be sensitive about the consequences related to gender aspects, as women are the key players in the post-harvest processes. As women share major part of the labour requirement, efforts for introduction of technology that helps in easing their work without they losing control over their occupation can be tried.

5) Sharing of best practices related to storage across the sites can help in managing pest problem in associated crops

Annexure – 1

SURVEY OF POST-HARVEST TECHNOLOGY AND CONSTRAINTS FACED BY WOMEN

S.No: | | | | | | | |

Interviewed by_____

Date:_____

I. Socio-economic status

1. Name of the Key informant :_____

2. Name and address of the head of the family _____

_____

3. Age (yrs) :_____ 4. Sex : Male [ ] Female [ ]

5. Religion and caste :-_____ 6. Caste :_____

7. Composition of the family : *Adults (>18 years):* Male [ ] Female [ ] *Children and adolescents:* Male [ ] Female [ ]

8. Land area cultivated including leased in and shared land in the last year: _____ Acres

9. Small millets and associated crops (SMAC) cultivation details last year before this season:

1_S.No.	2_SMAC	3_As main crop or inter crop	Last year area *(in acres)*	
			4_Kharif	5_Rabi
1	Little millet			
2	Finger millet			
3	Horsegram			
4	Niger			

II. Post-harvest Technologies and constraints (The following tables are with reference to the area cultivated for each SMAC last year)

10. Details of Post-harvest drying, staking and transporting to threshing place of last year crops:

1_S.No	2_SMAC	3_Describepost-harvest drying, staking and transporting to threshing place in terms of how, when (days after harvest and month) and where they are done?	4_Labour in mandays for each operation		5_Constraints faced	6_Efforts done to address each constraint
			M	F		
1	Little millet					
2	Finger millet					
3	Horsegram					
4	Niger					

Note: M- Male; F- Female

11. Grain/pod/kernel separation details of last year crops:

1_S.No	2_SMAC	3_Describe grain/pod/kernel separation method, in terms of the different activities like threshing, winnowing, etc. when (days after harvest, month), how and where they are done?	4_Labour in mandays for each operation		5_Constraints faced	6_Efforts done to address each constraint
			M	F		
1						
2						
3						

4						

Note: M- Male; F- Female

12. Details of drying of grains/kernals/pods of last year crops:

1_S.No	2_SMAC	3_Drying method followed	4_When drying done?	5_Duration of drying (days)	6_Done by *(code)*	7_ Constraints faced	8_Efforts done to address each constraint
1							
2							
3							
4							
					7: Done by *Female-1 Male--- 2 Transgende*		

					r -3 *Both----4*		

13. Storage of grains/kernals/pods of last year crops:

1_S.No	2_SMAC	3_Form of storage	4_Type of storage container	5_Duration of storage (days)	6_Done by *(code)*	7_ Infestations faced	8_Details of efforts done to address infestation, both preventive and after infestation
1							
2							
3							
4							
					7: Done by *Female-1* *Male--- 2* *Transgender -3* *Both----4*		

14. Storage of seeds of last year crops:

1_S.No	2_SMAC	3_Form of storage	4_Type of storage container	5_Duration of	6_Done by	7_ Infestations faced	8_Details of efforts done to address infestation, both preventive and

				storage (days)	*(code)*		after infestation
1							
2							
3							
4							
					7: Done by *Female-1 Male--- 2 Transgender -3 Both----4*		

15. Details of processing of SMAC:

1_S.No.	2_SMAC	3_Processed product *(code)*	4_Description of the processing method including type of machinery used, different steps, quantity per batch, conversion ratio, frequency, storage of processed item, etc.	5_Place *(code)*	6_Price /fees	7_Time taken (hrs)	8_Done by *(code)*

		3: Processed product *Rice----------1* *Grit----------2* *Flour---------3* *Others, specify-------99*		**5: Place** *Home-------1* *Own village-2* *Nearby village-------3* *Others, specify-----99*			**7: Done by** *Female---1* *Male----- 2* *Transgender -3* *Both-------4*

16. Mention three important processing constraints faced by you related to each SMAC (in the last 2-3 years)

1_S. No.	2_SMAC		3_Processing related constraints	4_Efforts done to address each constraint
1		1		
		2		
		3		
2		1		
		2		
		3		
3		1		
		2		
		3		
4		1		
		2		
		3		

17. Post-harvest losses: (Include both quantity and quality loss like spoilage of grains eg: poisoning of kodo millet)

18. Any other details of importance:

_____

_____

_____

_____

_____

_____

_____

Annexure – 2

Result of pair-wise ranking among male participants in Kaskikot VDC, Kaski, Nepal

Problems	Double harvesting(a)	Mental pressure for softening of heads (b)	Threshing is difficult ©	Dehulling is difficult (d)	Winnnowing is difficult (e)	More labor requirement (f)	More involvement of women (g)	Problem of rodents (h)	More duration of drying (i)
Double Harvesting (a)	x	a	c	a	E	a	g	a	a
Mental pressure for softening of heads (b)		x	c	d	E	f	g	b	i
Threshing is difficult ©			x	c	E	c	c	c	c
Dehulling is also difficult (d)				x	E	d	d	d	d
Winnowing is difficult (e)					X	f	e	e	e
More laborlabor requirement (f)						x	f	f	i
More involvement of women (g)							X	g	i
Problem of rodents (h)								x	i
More duration of drying (i)									X
Total score	5	1	7	5	7	4	3	0	4
Rank	III	VIII	II	IV	I	VI	VII	IX	V

Result of pair-wise ranaking among female participants in Kaskikot VDC, Kaski, Nepal

	Double harvesting (a)	Mental pressure for softening of heads(b)	Threshing is difficult ©	Dehulling is difficult (d)	Winnnowing is difficult (e)	More labor requirement (f)	More involvement of women (g)	Problem of rodents (h)	More duration of drying (i)
Double Harvesting (a)	x	b	c	D	E	f	a	a	a
Mental pressure for Softening of heada (b)		x	c	D	E	f	g	h	i
Threshing is difficult ©			x	C	C	f	c	c	c
Dehulling is also difficult (d)				x	E	f	d	d	i
Winnowing is difficult (e)					X	f	e	e	i
More laborlabor requirement (f)						x	f	f	f
More involvement of women (g)							x	g	g
Problem of rodents (h)								x	i
More duration of drying (i)									x
Total score	3	1	7	4	5	8	3	1	4
Rank	VI	IX	II	V	III	I	VII	VIII	IV