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Training needs assessment of smallholder farmers in rice post-harvest value addition technologies in the Southern Region of Sierra Leone

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Training needs assessment study was conducted on rice post-harvest value addition technologies. The study was done in the Southern Region of Sierra Leone to assess the competence of smallholder farmers in rice post-harvest value addition. As a quantitative research method, a descriptive research design, which called for a survey by randomly and proportionately selecting 400 smallholder farmers across the four districts in the region (Bo, Bonthe, Moyamba, and Pujehun) was done. Quantitative primary data were sought from smallholder farmers through a structured interview schedule that contained 55 post-harvest value addition items. Training needs of smallholder farmers in rice post-harvest value addition were analyzed and ranked by using the Mean Weighted Discrepancy Score (MWDS) of the Borich Needs Assessment Model. Use of power tiller (10.48), harvesting paddy with combine harvester (9.95), keeping moisture content of grains at or below 14% wet basis (8.98), use of rice separator to grade broken rice (8.91), use of a machine to remove unfilled grains (8.34), and use of moisture meter to test for moisture content in rice (8.16) were among the highly ranked rice post-harvest value addition items where priority training needs were expressed by smallholder farmers in the study area districts.

Key words: Competence, post-harvest technologies, smallholder farmers, Southern region, training needs, value addition.

INTRODUCTION

Training programmes are typically underfunded, and the capacities of service providers too are very limited (FAO, 2014). Accordingly, a training needs assessment can be determined externally. Often what is good for the farmers,

or is necessary, there is a lack of eagerness to follow the training sessions organized for them (Pierre-andré et al., 2010). The training content/manual for smallholder farmers on post-harvest management practices of rice consists of harvesting, threshing, winnowing, drying, storing, and milling of the paddy (FAO, 2007 as cited in UNIDO, 2016).

Moreover, rice harvesting and threshing processes differ greatly from farmer to farmer and country to country. Mechanization levels also vary greatly from country to country. The processes might be manual, animal-powered, or mechanical. On the other hand, the training of farmers also contributes essentially to the development of human resources in agriculture. For farmers, their basic training needs include crop-wise information, namely improved crop seed, intercultural operation, right fertilizers, soil testing equipment, irrigation facilities, new farming implements, plant protection practices, cultivation of mushrooms, poultry production, sources of credit information, and animal husbandry (Rahman et al., 2018). Some of the major post-harvest training needs of farmers for rice value chain development in Ghana (Ampadu-Ameyaw et al., 2017) include better agricultural technologies in rice production, improvement in the quality of rice product, effective record keeping, marketing of rice, and business management.

Messick (1984 as cited in Glaesser and Glaesser, 2019) defined competence as what a person knows and can do in a particular way where both knowledge and skills are needed either by instructing the learner or by experience and otherwise. Further, they stated in the same paper that competence is the 'knowledge of an individual and what he can do under ideal situations. Azevedo et al. (2009) defined skill as a specific form of capacity that is typically inherent among people or teams that are useful in some unique circumstances or linked to using specialized resources, whilst knowledge is the collection of the belief system of an individual concerning casual occurrences.

Extension as a non-formal means of education provides advisory services by the use of an educational process to assist farmers to acquire knowledge and skills to effectively catch up with their own needs and problems they face in their very socio-economic contexts (Khan, 2016). Nowadays, a key universal challenge that requires farmers' competence is how to make food security possible for the world growing population and to ensure long-lasting sustainable development (Man et al., 2016). The agricultural extension agents must seek solutions to the constraints that limit the efficiency and productivity of other actors in the chain, and the development of cooperative relationships among actors (Ammani and Abdullahi, 2015).

This is important because, it is indicative that Sierra Leone's inability to achieve food sufficiency and food security in rice production is partly due to poor value addition, which is also due to the lack of ability of agricultural extension agents and farmers to develop effective rice value addition technologies.

The general objective of this study was to determine the rice post-harvest training needs of smallholder farmers by the use of the Borich needs assessment model. Specifically, the study sought the following objectives:

1. To identify the socio-demographic characteristics of smallholder farmers
2. To assess the levels of importance attached to rice post-harvest value addition
3. To determine the competence of farmers in rice post-harvest value addition
4. To investigate the training needs of farmers for rice post-harvest value addition.

METHODOLOGY

The study area was the Southern Region of Sierra Leone comprising four districts, namely: Bo, Bonthe, Moyamba, and Pujehun. The study focused on the sample size (n) of 400 smallholder farmers. The sample size was determined by the use of the Miller and Brewer (2003) sampling technique formula:

Sample size (n) = $N/1 + N(\alpha)^2$

where N=sample frame, n = sample size, and α = margin of error at 95% confidence level. With no available data on the total number of smallholder farmers in the region, 157,114 farming households (Statistics Sierra Leone, 2016) were used as the sample frame from which the sample size of 400 farming households was drawn. Each household represented a smallholder farmer giving a total sample size of 400 smallholder farmers. These were randomly and proportionally selected from the four districts of the region that were involved in rice post-harvest value addition who successfully completed the interview. A structured interview schedule consisting of 55 value addition items and their socio-demographic characteristics was administered to farmers and their responses were recorded by the enumerators. Both importance and competence of the farmers were measured on a 5 point Likert-type scale. The ratings for measuring importance were: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important. Similarly, the ratings for measuring competence were on a scale of 1=incapable, 2=less capable, 3=moderate, 4=capable, and 5=highly capable. The face validity of the interview schedule was made by my supervisors in the Department of Agricultural Economics and Extension, University of Cape Coast, Ghana. The two thesis supervisors thoroughly reviewed the items in the research instrument by ensuring that all items in the instrument were aligned with the specific objectives of the study. The outcome of the assessment by the supervisors was their joint approval of the instrument to undertake the research. The Cronbach Alpha Reliability Test Coefficients for the interview schedule ranged from the least value of 0.674 to 0.971 as the highest of the 10 constructs. Averagely, the Cronbach Alpha Reliability Test Coefficients was 0.79 which shows that the instrument had an internal consistency and was therefore reliable. Data were processed with the aid of the Statistical Package for Social Science (IBM SPSS) version 25.0 software. Descriptive statistics which involved frequencies, percentages, means, and standard deviations were utilized in data analysis.

Calculation of the Mean Weighted Discrepancy Score (MWDS) was done to establish the inclusive rankings for each of the competency items. The following statistical procedures were used to establish the MWDS.

(a) A discrepancy score (DS), or the difference between the importance rating and the competence rating was calculated for each farmer on each competency item by subtracting the competence rating from the importance rating

(b) A weighted discrepancy score (WDS) was calculated for each respondent and each of the value addition competencies by multiplying the discrepancy score by the mean importance rating.

(c) A MWDS for each of the competencies was calculated by taking the sum of the weighted discrepancy scores (WDS), and dividing it by the total number of observations/respondents.

Thus, the Borich Needs Assessment Model is as follows:

$$MWDS = [(Iith − Cith) \times X_i/N$$

$$MWDS = [(Importance − Competence) \times Importance\ Mean]\,/N,$$

where I = importance rating for each item; C = competency rating for each item; X_i = mean of the importance rating; N = number of respondents/observations. Using the MWDS, the training needs for smallholder farmers were then ranked (Alibaygi and Zarafshani, 2008; Borich, 1980).

RESULTS AND DISCUSSION

Objective one: Identify the socio-demographic characteristics of smallholder farmers

The socio-demographic data of the smallholder farmers in the Southern Region of Sierra Leone shown in Table 1 depict that male smallholder farmers (74.0%) outnumbered their female counterparts who took part in the study. The mean age of farmers was 43.09 years with a standard deviation of 8.33 years. Married farmers were in the majority (83.5%) with 26.5% of the totality of the farmers having no form of education. However, 25.8% had non-formal education whereas the rest had some form of formal education. Nearly half of the respondents (45.8%) had 6-10 household size of family members with a mean household size of 12 members and a standard deviation of 4.46. About 87.0% of the farmers have farming as their main source of income whilst 74.8% practised micro-business as their alternative livelihood. Farming is the main source of income for more than four-fifths (86.5%) of the farmers, and the primary occupation of the majority of the respondents (77.8%) with a mean of 14 years and a standard deviation of 8.37 years as their number of years in farming. Thirty-eight percent of the farmers grow both local and improved varieties of rice whilst nearly half (49.0%) used family as their source of farm labour. For land ownership type, more than half (61.5%) of the farmers farmed on family land with 40.8% cultivating rice on the inland valley ecology (IVS). More than half of the farmers (55.2%) do not belong to any farmer based organization even though 60.3% considered extension agents as their source of

information in rice post-harvest value addition and marketing. Finally, a greater majority of the farmers (80.5%) had no access to credit for their farming activities. Older farmers are more competent and experienced in selling agricultural goods than younger farmers (Markussen et al., 2018). Similarly, in Sierra Leone, Mansaray and Jin (2020) observed that the mean age of farmers was 45 years in their study to examine food security issues in the country. The more advanced are smallholder farmers in age, the greater their agricultural competencies (all things being equal), and this means that older farmers face more risks than younger farmers (Nouman and Syed, 2013). However, another study by DHS (2019) in Sierra Leone shows that 79% of the respondent farmers have some level of education. On the contrary, a study by Tarway-twalla (2013) in Liberia shows that thirty-seven percent of smallholder farmers had no form of education, whereas 5% had a degree or college education. On the whole, rice-growing smallholder farmers who were better educated and attended more association meetings and field demonstrations were more inclined to use part or all of the technology options available to them in rice production (Tsinigo and Behrman, 2017). The aforementioned empirical shreds of evidence on education as a predictor of the rate of adoption of agricultural technologies are overwhelming. It is therefore not surprising that education and training are usually important components of extension related programmes or projects in developing countries.

Objective two: Assess the levels of importance farmers attached to rice post-harvest value addition

Table 2 shows a list of 55 rice value addition construct items for smallholder farmers. The farmers were asked to rate their level of importance of the post-harvest value addition technologies on a 5-point Likert-type scale of: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important. The actual mean is 3, due to the rating scale; hence, a mean higher than 3 represented high importance, while a mean lower than 3 represented low importance of the rice post-harvest value addition technologies. The results from the analysis unquestionably, therefore, showed that high importance is associated with the rice post-harvest value addition technologies by smallholder farmers. It indicated that, out of the 55 important value addition items, only four of them were rated as low importance by farmers. This signifies that the means of all of the other 51 value addition items were greater than the limit/cutoff point of 3. Rice post-harvest technologies to which farmers attached high importance include: the use of tarpaulin/plastic sheet to dry paddy (mean=4.32, S.D.=2.25), use of concrete/drying floor to dry paddy (mean=4.22, S.D.=0.94), use of round shape-weaved bamboo-strip

Table 1. Socio-demographic characteristics of smallholder farmers in the study areas.

Socio-demographic variable	Frequency	Percentage
District		
Bo	115	28.8
Bonthe	84	21.0
Moyamba	109	27.2
Pujehun	92	23.0
Sex		
Male	296	74.0
Female	104	26.0
Age (completed years)		Mean=43.09, S.D.=8.33
20-29	18	4.5
30-39	128	32.0
40-49	177	44.2
50-59	59	14.8
60+	18	4.5
Marital status		
Single	14	3.5
Married	334	83.5
Co-habiting	15	3.8
Divorced	12	3.0
Widowed	25	6.2
Highest educational level (n=191)		
No education	106	26.5
Non-formal	103	25.8
Primary	22	5.5
Junior Secondary School (JSS)	65	16.3
Senior Secondary School (SSS)	43	10.8
Technical/Vocational	47	11.8
Tertiary	14	3.5
Household size		Mean=10.10, S.D.=4.46
1-5	44	11.0
6-10	183	45.8
11-15	128	32.0
16-20	32	8.0
20+	13	3.2
The main source of income		
Farming	346	86.5
Employment	15	3.8
Commerce	33	8.2
Family remittance	6	1.5
Primary occupation		
Farming	311	77.8
Fishing	23	5.8

Table 1. contd.

Skilled work	5	1.3
Teaching	19	4.8
Trading	39	9.8
Employment	3	0.8
Farming years		Mean=14.06, S.D. 8.37
<10	132	33.0
10-19	164	41.0
20-29	77	19.3
30-39	20	5.0
40+	7	1.8
Variety of rice cultivated		
Improved	105	26.2
Local	143	35.8
Both	152	38.0
Source of labour		
Family	196	49.0
Hired	154	38.5
Rotatory	49	12.3
Individual	1	0.2
Land ownership		
Personal	95	23.8
Family	246	61.5
Rented	42	10.5
Leased	17	4.2
Farm ecology		
Upland	153	38.3
Inland valley swamp	163	40.8
Boli land	73	18.2
Mangrove	11	2.8
Membership in farmers based organizations (FBO)		
Yes	179	44.8
No	221	55.2
Source of information on rice post-harvest value addition and marketing		
Extension agents	241	60.3
Local mass media	25	6.3
Colleague farmers	132	33.0
Traders/marketers	2	0.4
Type of credit received		
None	322	80.5
Cash	26	6.5
In-kind	29	7.2
Both	23	5.8

Source: Kamanda, Field Survey (2021).

Table 2. Levels of importance farmers attached to rice post-harvest value addition technologies.

Post-harvest value addition competence	Importance		Level of importance
	Mean	**S.D.**	
Technologies used to harvest paddy			
Harvesting paddy with a combine harvester	3.95	1.21	High
Use of moisture meter to determine moisture content in paddy	3.33	1.26	High
Use of planting calendar to determine harvesting date	3.68	1.05	High
Harvesting paddy with handheld sickles	3.68	1.05	High
Harvesting paddy by cutting straws 4-5 cm above the ground level	3.34	1.02	High
Harvesting paddy with a knife to select panicle	4.10	0.96	High
Technologies used by farmers to heap paddy			
Heaping harvested paddy for not more than a day	3.55	1.08	High
Heaping paddy on tarpaulin	4.06	0.91	High
Use of coned heap style to pack paddy	3.24	1.07	High
Technologies used by farmers to transport paddy			
Use of power tiller to transport paddy	3.94	1.30	High
Use of baskets to transport paddy by humans	3.94	1.02	High
Use of bags to transport paddy by humans	4.20	0.89	High
Technologies used by farmers to thresh paddy			
Use of threshing machine	3.93	2.28	High
Threshing paddy the very day it is harvested	3.75	1.11	High
Threshing paddy with feet on tarpaulin	4.17	0.89	High
Beating paddy straws in bags to remove grains from panicles	3.36	1.19	High
Threshing paddy with feet on the mud floor	3.03	1.05	High
Whipping paddy straws on the floor with sticks to remove grains	3.88	1.74	High
Threshing paddy with feet on concrete/dying floor	3.99	0.97	High
Drying wet paddy before it is threshed	3.07	1.36	High
Technologies used by farmers to winnow paddy			
Use of round shape-weaved bamboo-strip manual winnower	4.21	0.91	High
Use of oscillating sieves and aspirators (mechanical winnower)	1.44	0.85	Low
Technologies used by farmers to parboil paddy			
Use of specialized parboiling container	3.10	1.48	High
Removal of unfilled/empty grains	4.07	1.09	High
Washing paddy twice with clean water	3.70	1.13	High
Soaking paddy for about 18 h in warm water	3.58	1.18	High
Use of rice separator/net to sieve broken grains from paddy	3.03	1.45	High
Use of jute bags to cover container during steaming	3.54	1.14	High
Removal of chaffs on paddy before soaking it	3.84	1.08	High
Steaming paddy for about 30-40 min	3.95	1.01	High
Technologies used by farmers to dry paddy			
Use of moisture meter to test for moisture content	3.55	0.10	High
Use of concrete/drying floor to dry paddy	4.22	0.94	High
Solar energy to dry paddy by occasionally stirring it to dry	3.49	1.37	High
Use of shed with fire underneath to dry paddy	3.19	1.99	High
Use of tarpaulin/plastic sheet to dry paddy	4.32	2.25	High
Use of mechanical dryer to dry paddy	3.68	1.78	High

Table 2. contd.

Technologies used by farmers to mill paddy			
Use of rice separator to grade broken rice	2.30	1.57	Low
Use of a machine to remove unfilled grains	3.62	1.06	High
Use of dehusking or dehulling machine to dehusk rice	3.69	0.99	High
Use of mechanical miller to mill rice	3.96	1.16	High
Use of de-stoner to remove stones/pebbles from rice	3.80	2.30	High
Technologies used by farmers to store paddy/rice			
Keep moisture content of grains at or below 14%.w.b	3.01	1.32	High
Use of sacks or jute bags to store rice	3.91	1.14	High
Cleaning storehouse three weeks before the arrival of fresh harvest	3.64	1.79	High
Use of containers	3.49	1.33	High
Use of rice barns	3.72	1.24	High
Checking moisture content of store by using a moisture meter	2.97	1.46	Low
Stack bags of rice 20 cm above the floor on wooden racks	3.47	1.19	High
Technologies used by farmers to package and market rice			
Use labels/tags for traceability/identification of rice types and quality	3.32	0.97	High
Weighing paddy on a scale to determine selling weight	3.89	1.01	High
Packing rice at 8-13% moisture content	3.30	1.36	High
Use of laminated and zipped bags to package rice	2.99	0.97	Low
Use of phone to facilitate marketing negotiations	3.06	1.17	High
Weighing rice on a scale to determine selling weight	3.64	1.32	High
Use groups to market rice	3.25	1.18	High

Source: Kamanda, Field Survey (2021).
n=400. Means were calculated on a scale of 1-5. Importance scale: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important.

manual winnower (mean=4.21, S.D.=0.91), use of bags to transport paddy by humans (mean=4.20, S.D.=0.89), threshing paddy with feet on tarpaulin (mean=4.17, S.D.=0.89), harvesting paddy with a knife to select panicle (mean=4.10, S.D.=0.96), removal of unfilled/empty grains (mean=4.07, S.D.=1.09), and heaping paddy on tarpaulin (mean=4.06, S.D.=0.96)

Other technologies farmers did not attach any importance to as shown in the results which include: the use of oscillating sieves and aspirators (mechanical winnower) (mean=1.44, S.D.=0.85), use of rice separator to grade broken rice (mean=2.30, S.D.=1.57), checking the moisture content of store by using a moisture meter (mean=2.97, S.D.=1.46), and use of laminated and zipped bags to package rice (mean=2.99, S.D.=0.97). Regardless of the numerous importance attached to rice post-harvest value addition technologies (Mossie et al., 2019) discovered in Ethiopia that smallholder farmers soon sell their paddies and end up buying them again at a higher cost simply because of a lack of improved storage facilities for their paddy after harvest. Against value addition, Danbaba et al. (2019) observed in Nigeria that massive grain loss occurs was recorded totaling 11.39% at different paddy post-harvest stages beginning

from harvesting stage (4.43%), threshing and cleaning (4.97%), transportation of paddy from the field to store (0.34%), drying and storage of paddy (1.53%) and transportation of paddy to local markets for sale (0.12%).

Objective three: Competence levels of smallholder farmers in rice post-harvest value addition

The farmers were asked to rate their levels of competence in rice post-harvest value addition technologies on a 5-point Likert-type scale of: 1=incapable, 2=less capable, 3=moderate, 4=capable, and 5=highly capable. The results are shown in Table 3 of Objective three. The actual mean is 3, due to the rating scale; hence, a mean higher than 3 represented high competence, while a mean lower than 3 represented low competence in the rice post-harvest value addition technologies. The findings of the study showed that, of the 55 value addition items, 35 of them scored a mean less than 3. These findings imply that farmers lack competence in those value addition technology areas.

However, value addition items where farmers exhibited high competence included the following: harvesting

Table 3. Levels of competence for smallholder farmers in rice post-harvest value addition technologies.

Level	Frequency	Percentage
Low competence	341	85.5
High competence	59	14.8

Source: Kamanda, Field Survey (2021).

paddy with knife to select panicle (mean=3.95, S.D.=1.04), heaping paddy on tarpaulin (mean=3.49, S.D.=1.20), use of basket to transport paddy by humans (4.13, S.D.=0.85), threshing paddy the very day it is harvested (mean=3.20, S.D.=1.34), threshing paddy with feet on tarpaulin (mean=3.33, S.D.=1.09), whipping paddy straws on the floor with sticks to remove grains (mean=3.90, S.D.=1.01), beating paddy straws in bags to remove grains from panicles (mean=3.13, S.D.=1.27), threshing paddy with feet on mud floor (mean=3.33, S.D.=1.79), threshing paddy with feet on concrete/drying floor (mean=3.05, S.D.=1.02), drying wet paddy before it threshed (mean=3.04, S.D.=1.32), use of round shape-weaved bamboo-strip manual winnower (mean=4.21, S.D.=0.91), removal of unfilled/empty grains (mean=3.27, S.D.=1.31), removal of chaffs on paddy before soaking it (mean=3.78, S.D.=1.08), steaming paddy for about 30-40 minutes (mean=3.41, S.D.=1.35), use of concrete/drying floor to dry paddy (mean=3.63, S.D.=1.45), use of tarpaulin/plastic sheet to dry paddy (mean=4.04, S.D.=1.10), use of sacks or jute bags to store rice (mean=3.59, S.D.=1.21), use of containers (mean=3.32, S.D.=1.40), use of barns (mean=3.00, S.D.=1.40)..

Competency levels of smallholder farmers in rice post-harvest value addition

The competency levels of smallholder farmers were investigated as shown in Table 3. The majority of the farmers (85.5%) had a low level of competence in rice post-harvest value addition technologies. Only 14.8% had high competence in the same technologies. This is an indication that with the low level of farmers' competence, training is required to fill the high competency gap among smallholder farmers in the study area.

Objective four: Investigate the training needs of farmers for rice post-harvest value addition

The post-harvest training needs of smallholder farmers are shown in Table 4 as were determined by the use of the Borich needs assessment model to calculate the mean weighted discrepancy scores (MWDS). The model dictates that the higher the MWDS value of the respondents, the more competence they require for their

rice post-harvest value technologies. Similarly, Oladele (2015) added that the greater the MWDS, the higher the needed competencies for the extension agents' professional roles. The highly ranked value addition training needs of the farmers for this study include the use of a power tiller to transport paddy (10.48), harvesting paddy with a combined harvester (9.95), use of a threshing machine to thresh paddy (8.27), use of moisture meter to test for moisture content (8.16), use of rice separator to grade broken rice (8.91), use of a machine to remove unfilled grains (8.34), keep moisture content of grains at or below 14% wet basis (w.b.) (8.98), and use of labels/tags for traceability/identification of rice types and quality (8.98). Several other value addition technologies scored less than 1.00 MWDS. This, therefore, implies that farmers do not require any training in such technologies. Key among them were threshing paddy with feet on concrete/drying floor (-0.48), threshing paddy before it is threshed (-0.173). In contrast to the aforementioned findings, Sajeev et al. (2012) found that management of weed and water, integrated pest and disease management, and integrated farming, were the highest ranked training needs of farmers in Manipur State in India.

CONCLUSIONS AND RECOMMENDATIONS

This study investigated the rice post-harvest training needs of smallholder farmers through the use of the Borich needs assessment model. It was realized that smallholder farmers placed high importance on rice post-harvest value addition technologies. In actual fact, the study further revealed that farmers lack competence in more value addition technologies than they have in others. The ramification for the importance farmers attached to value addition technologies as against their low level of competence calls for a need for training farmers in the prioritized need deficit areas. These among others are not limited to the use of a power tiller in the transportation of paddy, harvesting paddy with a combine harvester, use of a threshing machine to thresh paddy after harvest, use of a moisture meter in testing for moisture content, use of rice separator to grade broken rice, use of a machine to remove unfilled grains from the paddy, keeping moisture content of grains at or below 14% w.b., and using labels/tags to trace/identify rice

Table 4. Use of Borich needs assessment model to determine the rice post-harvest value addition training needs of smallholder farmers.

Post-harvest value addition competence	Importance		Competence		MWDS	Rank
Technologies used to harvest paddy	Mean	S.D.	Mean	S.D.		
Harvesting paddy with a combine harvester	3.95	1.21	1.41	0.73	9.9457	1
Use of moisture meter to determine moisture content in paddy	3.33	1.26	1.61	0.85	5.7190	2
Use of planting calendar to determine harvesting date	3.68	1.05	2.23	0.98	5.2904	3
Harvesting paddy with handheld sickles	3.68	1.05	2.69	1.27	3.6082	4
Harvesting paddy by cutting straws 4-5 cm above the ground level	3.34	1.02	2.56	1.20	2.6322	5
Harvesting paddy with a knife to select panicle	4.10	0.96	3.95	1.04	0.5941	6
Technologies used by farmers to heap paddy						
Heaping harvested paddy for not more than a day	3.55	1.08	2.85	1.20	2.4549	1
Heaping paddy on tarpaulin	4.06	0.91	3.49	1.20	2.3128	2
Use of coned heap style to pack paddy	3.24	1.07	2.95	1.18	0.2850	3
Technologies used by farmers to transport paddy						
Use of power tiller to transport paddy	3.94	1.30	1.29	0.59	10.4801	1
Use of baskets to transport paddy by humans	3.94	1.02	3.85	1.03	0.3743	2
Use of bags to transport paddy by humans	4.20	0.89	4.13	0.85	0.2833	3
Technologies used by farmers to thresh paddy						
Use of threshing machine	3.93	2.28	1.67	1.43	8.2674	1
Threshing paddy the very day it is harvested	3.75	1.11	3.20	1.34	4.7121	2
Threshing paddy with feet on tarpaulin	4.17	0.89	3.33	1.09	3.1421	3
Beating paddy straws in bags to remove grains from panicles	3.36	1.19	3.13	1.27	0.7722	4
Threshing paddy with feet on the mud floor	3.03	1.05	3.33	1.79	0.7487	5
Whipping paddy straws on the floor with sticks to remove grains	3.88	1.74	3.90	1.01	0.1073	6
Threshing paddy with feet on concrete/dying floor	3.99	0.97	3.05	1.02	-0.488	7
Drying wet paddy before it is threshed	3.07	1.36	3.04	1.32	-1.725	8
Technologies used by farmers to winnow paddy						
Use of round shape-weaved bamboo-strip manual winnower	4.21	0.91	4.21	0.91	5.0000	1
Use of oscillating sieves and aspirators (mechanical winnower)	1.44	0.85	1.44	0.85	4.3731	2
Technologies used by farmers to parboil paddy						
Use of specialized parboiling container	3.10	1.48	1.61	0.97	5.1055	1
Removal of unfilled/empty grains	4.07	1.09	3.27	1.31	4.2769	2
Washing paddy twice with clean water	3.70	1.13	2.54	1.20	3.9110	3
Soaking paddy for about 18 h in warm water	3.58	1.18	2.49	1.18	2.4780	4
Use of rice separator/net to sieve broken grains from paddy	3.03	1.45	1.35	0.65	2.1859	5
Use of jute bags to cover container during steaming	3.54	1.14	2.84	1.54	1.8678	6
Removal of chaffs on paddy before soaking it	3.84	1.08	3.78	1.08	1.1803	7
Steaming paddy for about 30-40 min	3.95	1.01	3.41	1.35	0.7376	8
Technologies used by farmers to dry paddy						
Use of moisture meter to test for moisture content	3.55	0.10	1.68	1.22	8.1597	1
Use of concrete/drying floor to dry paddy	4.22	0.94	3.63	1.45	7.1329	2
Solar energy to dry paddy by occasionally stirring it to dry	3.49	1.37	1.89	1.37	6.6474	3
Use of shed with fire underneath to dry paddy	3.19	1.99	2.79	1.27	5.9299	4
Use of tarpaulin/plastic sheet to dry paddy	4.32	2.25	4.04	1.10	2.5033	5
Use of mechanical dryer to dry paddy	3.68	1.78	1.62	1.30	0.4050	6
Technologies used by farmers to mill paddy						

Table 4. Contd.

Use of rice separator to grade broken rice	2.30	1.57	1.35	0.65	8.9051	1
Use of a machine to remove unfilled grains	3.62	1.06	1.37	1.24	8.3429	2
Use of dehusking or dehulling machine to dehusk rice	3.69	0.99	1.43	0.83	7.8457	3
Use of mechanical miller to mill rice	3.96	1.16	1.98	1.16	4.2454	4
Use of de-stoner to remove stones/pebbles from rice	3.80	2.30	1.45	0.84	1.7944	5
Technologies used by farmers to store paddy/rice						
Keep moisture content of grains at or below 14%.w.b	3.01	1.32	2.35	1.24	8.9801	1
Use of sacks or jute bags to store rice	3.91	1.14	3.59	1.21	3.2352	2
Cleaning storehouse three weeks before the arrival of fresh harvest	3.64	1.79	2.75	1.27	2.4758	3
Use of containers	3.49	1.33	3.32	1.40	1.9924	4
Use of rice barns	3.72	1.24	3.00	1.40	1.6827	5
Checking moisture content of store by using a moisture meter	2.97	1.46	2.13	1.52	1.5076	6
Stack bags of rice 20 cm above the floor on wooden racks	3.47	1.19	2.95	1.29	1.2308	7
Technologies used by farmers to package and market rice						
Use labels/tags for traceability/identification of rice types and quality	3.32	0.97	1.34	0.63	8.9801	1
Weighing paddy on a scale to determine selling weight	3.89	1.01	1.58	1.22	7.0973	2
Packing rice at 8-13% moisture content	3.30	1.36	2.01	1.03	7.0319	3
Use of laminated and zipped bags to package rice	2.99	0.97	1.17	0.47	6.5471	4
Use of phone to facilitate marketing negotiations	3.06	1.17	2.45	1.10	3.3342	5
Weighing rice on a scale to determine selling weight	3.64	1.32	1.68	1.21	2.9328	6
Use groups to market rice	3.25	1.18	2.22	1.18	1.8743	7

Source: Kamanda, Field Survey (2021).
n=400. Means were calculated on a scale of 1-5. Importance scale: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important. Competence scale: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.

types and quality. From the foregone findings and conclusions of the study, it is worth noting that all technologies identified as the high MWDS items are the priority training needs for smallholder farmers which can be cascaded to other regions in the country to enhance the capacity of smallholder farmers in rice post-harvest value addition.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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