Africa RISING Technical Report Template

Instruction:

This template should be used for interim and full technical reports.

Reporting Period: FULL REPORT (1ST FEBRUARY 2021 TO 31TH AUGUST 2021)

Section A. Partner Information

A.1. Institution: CSIR-STEPRI

A.2. Contact person: DR. RICHARD AMPADU AMEYAW

A.3. Intervention sites, country: Africa RISING and non-Africa RISING communities in three regions of northern Ghana

Three regions in northern Ghana were visited during the dissemination exercise. These were Northern, Upper East and Upper West regions. Sixteen (16) communities were visited in seven (7) districts in the selected three regions. The breakdown of the various regions, districts and communities are reported in Table 1.

Table 1: Communities Visited in the Northern Regions of Ghana

REGIONS	DISTRICTS VISITED	COMMUNITIES
Northern Region	Savelugu	Kpendua, Langa, Tibali, Moglaa
	Tolon	Tingoli
	Kumbungu	Chayohi, Kpachi
Upper West Region	Nadoli – Kaleo	Goli, Nator
	Wa West	Guo, Zanko, Duosi
Upper East Region	Bongo	Nantanga, Sambolugo
	Kasena Nankana Municipal	Gia, Nyangua

A.4. Other partners: IITA, Tamale

Section B. Progress/achievements during the reporting period

Executive summary of achievements

The interim report focus on the sub-activity **GH4111-20**, *"Conduct representative technological pathway analysis on adoption of technologies taking various socioeconomic and biophysical dimensions into consideration".*

During the research period the team visited a total of sixteen community which participated in the community/stakeholder engagement. Overall five hundred and twenty one farmers were reached. The key issues during dissemination exercise were in five research categories. These were Agricultural Mechanization, Simulation of Sustainable Intensification Practices (SIPs), Impacts of Sustainable Intensification Practices (SIPs), Inputs Markets and Outputs Markets. Farmers shared some of the practical knowledge they have acquired in the Sustainable Intensification Practices (SIPs). These include, Row planting of maize and intercropping with cowpea or beans, Burying of fertilizer along the crop root, Use of cover crops and living mulch, Use of improved varieties that are early maturing and draught resistant and Maize Leaf Stripping. In addition the team also conducted a sustainable intensification practices adoption with emphasis on gender disaggregated analysis**.** The type of data collected was basically quantitative data sourced from both farming households (primary survey) and scientist and researchers who developed the various crop-livestock technologies being promoted and practiced (Secondary). The data collected covered key variables such as household size, number of farms, farm sizes, livestock size, quantities and prices on inputs such as seeds, labour, fertilizer and manure, outputs on crop yields, non-agricultural income, net returns on crops and livestock, nutrition and food security, and access to finance and extension services. A total sample size of four hundred and sixty five (465) farmers was purposively sampled from three northern regions (Upper West, Upper East, and Northern Region) for the household survey. This is made up of about 238 sustainable intensification practices adopters under the Africa RISING Project and 227 non-adopters. This is to enable the study estimate the parameters of the logistic regression of the factors that determine SIPs adoption on gender bases. A total of 12 communities were covered across 6 districts for the gender disaggregated analysis of the SIPs adoption. Whereas 16 communities were covered for the research report dissemination exercise. Some observable characteristics determining technologies adoption indicates that sustainable intensification practices development and transfer adption increases with age of women farmers. The results show that middle age and older women are more likely to adopt new technologies as opposed to the younger females. Farmer Based Organization membership increases adoption of sustainable intensification practices by 69%. Further, no education the likelihood of adoption may increase by no more than one-fifth (19%). But since majority (75.1% for male and 85.6% for females) of the farmers have no formal education it will therefore be important to provide regular onsite training to continually upgrade their level of knowledge and practices in the given technologies.

Table 1: Achievements (progress and/or results) against outputs towards outcome 4

Project Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices.				
Output 4.1: Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices at scale.	Planned Activities 1. Data organisation and analysis 2.Community/Stakeholder engagement 2. Technology analysis	Planned Milestones Household data sets were extracted for Technology analysis To disseminate the outputs of the projects to stakeholders	Deviation from Planned Milestones There was no deviation for the planned milestones	Achievements towards Output 16 communities were visited for the community/stakeholder engagement

Tables and graphs in support of achievements

In Table 2, it can be observed that 200 farmers were reached during the dissemination exercise at Northern Region. That is 141 farmers were males whilst 59 were females.

In the Upper West Region, 253 farmers were also reached during the dissemination exercise. More female farmers (134) than male (119) were reached during the dissemination exercise in the Upper West Region.

Furthermore, at the Upper East Region, 68 farmers were reached during the dissemination exercise. This includes 36 female farmers and 32 male farmers.

In total the CSIR-STEPRI dissemination exercised captured a total number 521 farmers in the three northern Ghana regions visited. The breakdown of the total number of farmers can be seen in Table 2.

Table 2: Number of farmers reached during dissemination exercise

Regions	Districts	Number of Communities	Male Farmers	Female Farmers	Total farmers
Northern Region	Savelugu	4	73 (63%)	42 (37%)	115
	Tolon	1	17 (85%)	3 (15%)	20
	Kumbungu	2	51 (78%)	14 (22%)	65
	Northern Region Total		**141 (70%)**	**59 (30%)**	**200**
Upper West Region	Nadoli - Kaleo	2	53 (54%)	45 (46%)	98
	Wa West	3	66 (43%)	89 (57%)	155
	Upper West Total		**119 (47%)**	**134 (53%)**	**253**
Upper East Region	Bongo	2	12 (335)	24 (67%)	36
	Kasena Nankana Municipal	2	20 (63%)	12 (37%)	32
	Upper East Total		**32 (47%)**	**36 (53%)**	**68**
GRAND TOTAL		**16**	**292 (44%)**	**229 (56%)**	**521**

Source: Dissemination Exercise by CSIR-STEPRI Team (2021)

The key issues during dissemination exercise were in five research categories. These were:

1. Agricultural Mechanization
2. Simulation of Sustainable Intensification Practices (SIPs)
3. Impacts of Sustainable Intensification Practices (SIPs)
4. Inputs Markets
5. Outputs Markets

ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

Interactions with Farmers

Farmers shared some of the practical knowledge they have acquired in the Sustainable Intensification Practices (SIPs). These include

- Row planting of maize and intercropping with cowpea or beans.
- Burying of fertilizer along the crop root.
- Use of cover crops and living mulch.
- Use of improved varieties that are early maturing and draught resistant
- Maize Leaf Stripping

Farmers are grateful to Africa Rising because of the corn shelling machine. According to the farmers it has eased their way of life in shelling corn. They also mentioned that the shellers are in good condition. But farmers revealed they were not taught how to repair the shellers when they breakdown. Secondly, parts to repair the shellers when they break are not found in the regional capitals let alone the district capitals, unless in Kumasi, which several miles away from the communities. These challenges sometimes hinder the effective use of the shellers. Farmers wish if these challenges can be resolved it help in the shelling of maize at the community level. The farmers requested that simple multi-purpose small agricultural implement should be made available to them for their farming activities. For instance farmers indicated the Shea butter extraction machine to process local oil.

Tractor and bullock ploughing services are inadequate and quite costly for the farmers during land preparation activities. This is because ploughing of farm lands during the raining season is a challenge. However, some communities indicated that spare parts for some agricultural implements are a challenge in the communities whilst there are limited skilled personnel to repair and maintain the implements.

Some Farmers indicated that they became fed up with research because they have participated in several research activities particularly answering of questionnaire but have not known the findings of the report and recommendations made to policymakers to address their needs. The farmers were therefore grateful that for the first time a research

team have returned to share and discuss the research studies conducted over the years with farmers. Meanwhile farmers indicated that they wish the Africa RISING project would continue.

Some farmers are losing interest in contract selling due to low prices as well as lack of contract enforcement. Also, the middlemen are not helping farmers because they dictate price without allowing for negotiation. The farmers were advised to form groups. The group system can help the farmers to access loans facilities in the form of inputs or cash for production activities and also put them in a better position to negotiate for better prices for their commodities.

Farmers have inadequate information on market prices and information. Farmers would want to be liaised with standardised of formal output markets in other to have stable and competitive prices.

Inadequate input dealers in the communities, farmers have to travel some distance to get inputs for their farming activities. In some instances farmers have to travel to the regional markets to purchase inputs. In addition pesticides are costly in the markets. There were also the concerns of some farmers indicating partisan share of state-sponsored inputs services at the community levels with special reference made to access to government subsided fertilizer. Table 3 expands on the issues that were shared during the dissemination exercise

Table 3: Key issues during dissemination exercise

Research category	Problem(s) identified	Solution(s) found	Recommendations
Agricultural Mechanization 	 Inadequate attention and investment in post-production agricultural activities	 Training and support for postproduction processes and marketing; to increase income (support from Africa RISING	 Collaboration with the private sector to build capacity, and companies to produce and/or assemble appropriate agricultural machinery, tools and equipment locally.

	 Focus on tractor services and neglect of other postproduction activities like grading and standardization, and storage	with group-owned and operated threshers) are needed.  There is the need for the state to collaborate with stakeholders to support or increase investment in postproduction activities	 Promote small-scale multipurpose machinery along the value chain, including farm-level storage facilities, appropriate agro-processing machinery/equipment and intermediate means of transport.  The importance of regular maintenance postproduction machinery (e.g. threshers) and observation of best postharvest production practices.
Research category	**Problem(s) identified**	**Solution(s) found**	**Recommendations**
Simulation of SIPs	 Lack of knowledge in SIPs	 Technology park trainings on efficient and productive production practices to increase yield	 Continuous adoption, promotion and sustained use of SIPs (Maize-cowpea living mulch, maize stripping, mixed

		and income to improve farm households' welfare	farming, row planting, and timing of planting, weeding (or weedicides), pesticides and fertilizer application.
 **Impact of SIPs adoption**	 Low productivity, income and welfare of farmers	 Farmers livelihoods have improved as a result of SIPs adoption	SIPs adoption improve productivity, income, and agricultural practices but **NOT** gender equity Impact of SIPs adoption on farm households' welfare (Consumption/nutrition [+], Healthcare [+], and Clothing [+])
Research category	**Problem(s) identified**	**Solution(s) found**	**Recommendations**
To get a better understanding of how input markets in their various forms work out 	Without access to extension services, a farmer is less likely (28% probability) to have access to inputs all things been equal. This is significant at 1%.	Access to extension services, implies that a farmer is more likely to have access to inputs all things been equal.	Farmer to farmer extension needs to be enhanced among farmers in the community to boost extension contacts. This would improve the flow of production and marketing information among various actors in the market chain.
	Access to financial services is	Access to financial services,	Strategies such as seeking private partnerships to make credit available to

	critical in enabling farmers to access input markets. Without access to financial services, a farmer is less likely (25% probability) to have access to input markets.	implies that a farmer is more likely to have access to inputs all things been equal.	farmers, through increased investments in training and logistics could improve input market access.
	Distance matters in farmer's access to input markets in northern Ghana. An increase in distance means that a farmer is less likely to have access to input market.	Distance matters in farmer's access to input markets in northern Ghana. The shorter the distance to the nearest market therefore impacts the input use and technology adoption.	Farmers should belong to FBOs and benefit from advantages such as higher prices/incomes from collective marketing, bulk delivery of inputs at a lower cost among others
	Farmers' access to guarantee market was low (18.3%) with a likely impact on their market participation decisions	Farmers need to have written contract agreements with either input dealers or traders who pre-finance their production	Improving market education among farmers will greatly enhance access to output markets.

 **To get a better understanding of how output markets in their various forms work out**		activities and in return receive grains after harvest	
	Farmer without access to market information would likely sell at the village market rather than use district and regional markets	A farmer's access to market information in the locality is linked with using district and regional markets as the main market outlet.	Market information is crucial to farmers as it is able to direct their activities to lucrative markets for participation
	Farmers without access to storage facilities are more likely to sell their outputs in the village market over the district and regional markets.	Farmers having access to storage facilities are associated with using district and regional markets as the main market outlet.	Developmental partners and NGOs could partner with farmer cooperatives and put up community storage houses for farmers to benefit and pay in kind or cash.
	A farmer not having knowledge in SI practices is associated with using farm gate as the main market outlet	A farmer with knowledge in SI is more likely to use the village market over the farm gate in marketing their produce	SI practices such as organic farming increase the incomes of farmers and also create new market opportunities outside the village markets especially in urban areas

Data and Sampling

The type of data collected was basically quantitative data sourced from both farming households (primary survey) and scientist and researchers who developed the various crop-livestock technologies being promoted and practiced (Secondary). The data collected covered key variables such as household size, number of farms, farm sizes, livestock size, quantities and prices on inputs such as seeds, labour, fertilizer and manure, outputs on crop yields, non-agricultural income, net returns on crops and livestock, nutrition and food security, and access to finance and extension services. A total sample size of four hundred and sixty five (465) farmers was purposively sampled from three northern regions (Upper West, Upper East, and Northern Region) for the household survey. This is made up of about 238 SIPs adopters under the Africa RISING Project and 227 non-adopters, who were part of the Africa RISING project's communities but who did not adopt the given technologies. A total of 12 communities were covered across 6 districts (**see Table 4**). Purposive, stratified and simple random sampling techniques were employed to collect the data from the respondents. Purposive sampling was used to select the communities and the respondents (SIPs adopters and non-adopters). For the stratified sampling, the population of the communities was divided into subgroups of two strata (SIPs adopters and non-adopters). Simple random sampling was then used to select each respondent to be interviewed. Represented in Table 4 are the number of respondents obtained from each district.

Table 4: Sample distribution across districts

Region	**District**	**Frequency**	**Percent**
Northern Region	Tolon	62	13.3
	Savelugu	96	21.1
Upper East Region	Kasina-Nankana	63	13.5
	Bongo	80	17.1
Upper West Region	Nadowli	91	19.6
	Wa West	71	15.3
		465	100.0

Analytical framework

The study utilised both the Probit regression model to analyse the factors that determine farmers access to decision to adopt SIPs. The theoretical foundations and the analytical framework regarding probit model are detailed below.

Probit Model - Theoretically, the decision of a household to adopt or otherwise of SIPs is influenced by certain factors (individual, demographic and institutional) (Anang et al., 2015; Sebopetji and Belete, 2009). Let the latent variable, Y_i represent the decision of a household to adopt SIPs and X_i represents independent variables, the quantitative response model can be written as:

$$Y_i = \alpha + \beta X_i + \mu_i \quad (1)$$

where α is the constant, β is the coefficient of parameters to be estimated, and μ_i is the error term.

Assuming that, X_i(vector of regressors) is influenced by the response variable, Z_i, the model takes the form:

$$\text{Probability}(Z_i = 1) = \emptyset(X_i\, \gamma) \quad (2)$$

where Z_i is the binary choice variable (0 or 1), $\emptyset$ depicts the Cumulative Distribution Function of the standard normal distribution, γ represents unknown parameters to be estimated, and X_i represents the explanatory variables included in the model. Z* is specified as:

$$Z*_i = \gamma_0 + \sum_{n=1}^{N} \gamma_n X_m + u_i \quad (3)$$

where N = sample size and Z_i = 1 if $Z*_i$>0; and Z_i= 0 otherwise. The maximum likelihood procedure is then followed to estimate equation [3] conveniently.

The Probit modeling approach usually produces estimates that lie between 0 and 1 (constrains probabilities) but poses a relaxed condition on the effects of explanatory variables on the predicted values of the dependent variable. The assumption is that only the values of 0 and 1 are observed for the dependent variable, but that a latent continuous variable $Z*_i$ exists which determines the value of the dependent variable, Z_i (Sebopetji and Belete, 2009). The empirical model estimated is of the form:

$$Y_i = \beta_0 + \sum_{j=1}^{n} \beta_j X_{ji} + v_i \quad (4)$$

where Y_i is binary variable (access to inputs by household), β_0 is the intercept, β_j are coefficients to be estimated, X_{ji} vector of independent variables, and v_i is the random error term.

$Y = BEN$ in Table….., $X = Various\ independent\ variables\ as\ defined\ in\ Table$ ……

The variables shall carry their individual meaning throughout the text as defined in Table…

Symbols	Independent variables	Measurement	Expected sign
UWR	Upper West Region	Dummy (1=Upper West Region, 0=otherwise)	+/-
UER	Upper East Region	Dummy (1=Upper East Region, 0=otherwise)	+/-
NOR	Northern Region	Dummy (1=Upper East Region, 0=otherwise)	+/-
AGE	Age	Years	+/-
MRS	Marital status	Marital status (1=married, 0=otherwise)	+/-
EDU	Educational level	Education (Number of years in school)	+/-
FBO	Membership of Farmer Based Organisations	Farmer Based Organisations (Membership of an FBO)	+
DTF	Residence-farm distance	Kilometers	+/-
CRD	Amount of credit received	Amount in GH₵	+
EXT	Access to extension services	Number of extension visit received in the cropping season	+
FSZ	Farm size	Hectares	+
PEC	Perception of ease of adoption	Dummy (1=easy to adopt, 0=otherwise	+/-

SLB	**Labour supply**	**Number of labourers used**	+/-

Descriptive Statistics

The results (Table 4) show that the males are 282 while the females are 181(Table 5), implying the number of respondents for the entire study are 463. This is because stata dropped one respondents each of the males and females categories. This normally happens when response for the variables in the model are not adequately answered by the respondents. Also, the summary statistics of the variables used in the probit model for males and females are reported in Tables 4 and Table 5 respectively. The mean age of the males (adopters and non-adopters) is 45.8 years while the females (adopters and non-adopters) is 47.7 years. It is intriguing to observe that the females in the study are older than the males because, in Africa there is intense drudgery associated to the production and marketing of agricultural commodities which makes it more ideal for the females to be younger than the males as has been found in other studies. In most instances the males have physical energy required (even if they are older than the females) to carry out these physically demanding farm operations.

Table 4: Descriptive of independent variable (males)

Variable	Objects	Mean	Standard Deviation.	Minimum	Maximum
BEN	282	.50	.50	0	1
UWR	282	.42	.50	0	1
UER	282	.20	.40	0	1
NOR	281	.38	.49	0	1
AGE	282	45.84	14.86	18	**98**
MRS	282	.94	.23	0	1
EDU	282	.77	.42	0	1
FBO	282	.59	.49	0	1
DTF	282	1.87	1.4	0	8
CRD	282	.15	.40	0	1
EXT	282	2.25	1.92	0	10
FSZ	282	6.12	4.20	1	32
PEC	282	.19	.39	0	1
SLB	282	.07	.25	0	1

Source: CSIR-STEPRI Team (2021)

Not surprisingly, in patriarchal societies like northern Ghana, the study observed that more females (mean=0.82; Table 5) than males (mean=0.77; Table 4) are likely to have no access to formal education (N.B. here no formal education=1, otherwise 0, because most of the respondents have no formal education). Also, more males (mean= 0.94) than

females (mean=0.74) are likely to marry. This is likely to be a cultural issue. It si also because males appear to have more farm labour needs than females, most often they rely on their wives and children for farming activities. But more females (mean=0.68) than males (mean= 0.59) are likely to belong to groups like farm based organisations. It is therefore unsurprising that females (mean=0.45) have better access to credit than males (mean=0.15). This is because these groups contribute to a Village Savings and Loans Schemes (VSLS), from where they can access loans if the need arises (mostly for the purpose of nonfarm business or activities). Membership of VSLS are mostly females. It is therefore important to establish why this is the situation. This funds are normally revolving around the group members, for which reason it is difficult to access by non-group members. Even if a non-group member will access it, it comes with high borrowing cost which is a disincentive or a deterring measure.

Residence-farm distance is shorter for males (mean=1.87km) than females (mean=2.40km). Even though most of the farms are located around the houses, it appears females have to go a longer distance to access farm lands. This may be so because of the patriarchal nature of the societies in which males inherit and become owners of production resources to the detriment of females. Males are then likely to select farm lands that productive and shorter in distance to obtain more output from the farms. This is also supported by the fact that males (mean=6.12ha) have bigger farmlands compare to females (mean=3.25ha). The implication is that males seem to control the production resources as observed in the data (Table 4 and 5).

Table 5: Descriptive of independent variable (females)

Variables	Objects	Mean	Standard Deviation	Minimum	Maximum
BEN	180	.53	.5	0	1
UWR	181	.21	.41	0	1
UER	181	.47	.50	0	1
NOR	180	.32	.7	0	1
AGE	181	47.69	13.89	20	81
MRS	181	.74	.44	0	1
EDU	181	.82	.387	0	1
FBO	181	.68	.47	0	1
DTF	181	2.40	1.76	.1	9

CRD	181	.453	.50	0	1
EXT	181	2.238	1.59	0	5
FSZ	181	3.251	2.14	1	15
PEC	181	.21	.41	0	1
SLB	181	.083	.28	0	1

Access to extension services is same for both males (mean= 2.25) and females (mean=2.24). This may be so because such services are provided not by households or communities but by state institutions and Non-Governmental Organisations (NGOs) for which reason there is equal opportunities for all. Also, there would be no justifiable reason for Agricultural Extension Officer (AEO) or agronomic scientist (especially from IITA) to get into a village and decides to offer his or her service to some selected farmers. It is for this reason that the state and private sector support for both male are females farmers are fairly distributed or accessed to ensure optimum yield. In addition, there is similarity in perception of ease of adopting the technologies by both females and males. The technologies (observing best agronomic practices, mixed farming, and mixed cropping) are easy to adopt. This is because 0.19 and 0.21 means are observed for ease of adoption by both males and females respectively. However, as revealed by farmers monetary resources are required to fully the technologies. Males (mean=0.7) rather than females (mean=0.08) are likely to rely on family labour. This is may be so because the literature and information gathered from the dissemination report suggest males are financially sound and therefore can afford to hire labour, and also because they have bigger farm sizes (as observed in the study) than females.

Observable Characteristics Determining Technologies Adoption by Males and Females

Reported in Table 6 and the Table 7 are the coefficients and marginal values of the probit regression for the females. However, interpretations are done based on the marginal values. The result shows an R^2 value 0.525%, implying the independent values i.e. UWR, UER, NOR, AGE, MRS, EDU, FBO, DTF, CRD, EXT, FSZ, PEC, and SLB explain about 52.5% variation in the dependent variable i.e. BEN. Three of the independent variables are statistically significant i.e. AGE ($p<0.05$), FBO ($p<0.01$) and FSZ ($p<0.05$). Except regional dummies (UWR, UER, NOR) and MRS, all the remaining variables influence SIPs adoption positively, although not statistically significant. AGE has a marginal value of 0.01 which implies a year increase in age of a female farmer would increase the probability of adoption by 1%. SIPs development and transfer to middle age and older women appears to be critical in promoting adoption among females.

But it should be noted that this will not continue *ad infinitum* since AGE is a trend variable.

Table 6: Probit regression results (females)

IDV	Coefficient.	Standard Error.	t-value	p-value	[95% Confidence	Interval]	Sig
UWR	**-4.192**	**225.591**	**-0.02**	**0.985**	**-446.342**	**437.957**	
UER	**-4.479**	**225.590**	**-0.02**	**0.984**	**-446.628**	**437.670**	
NOR	**-4.591**	**225.590**	**-0.02**	**0.984**	**-446.740**	**437.558**	
AGE	0.024	0.010	2.34	0.019	0.004	0.045	**
MRS	-0.019	0.334	-0.06	0.954	-0.673	0.635	
EDU	0.380	0.350	1.09	0.277	-0.306	1.066	
FBO	2.124	0.322	6.60	0.000	1.494	2.755	***
DTF	0.055	0.069	0.79	0.428	-0.081	0.191	
CRD	0.375	0.330	1.14	0.256	-0.271	1.021	
EXT	0.142	0.090	1.58	0.113	-0.034	0.318	
FSZ	0.012	0.063	0.19	0.851	-0.112	0.136	
PEC	0.679	0.318	2.14	0.033	0.056	1.302	**
SLB	0.164	0.484	0.34	0.734	-0.784	1.112	
Constant	0.796	225.592	0.00	0.997	-441.356	442.948	

Mean dependent variable	0.536	SD dependent variable	0.500
Pseudo r-squared	0.438	Number of objects	179.000
Chi-square	108.378	Probability > Chi^2	0.000
Akaike critical.	166.824	Bayesian crit.	211.447

(AIC)		(BIC)	
*** *p<0.01, ** p<0.05, * p<0.1* ; IDV (Independent variables)			

FBO membership increases adoption by 69% because it has a marginal value of 0.687 (Table 7). FBO members offer support in terms of loans, networking, information sharing and peer influence. This can then help to promote SIPs adoption among members.

Marginal effects after probit
y = Pr (BEN) (predict)
= .52507737

Table 7: Marginal effects of probit results (females)

IDV	dy/dx	Standard Error	z	P>z	[	95%	C.I.
UWR	-0.83	12.507	-0.070	0.947	-25.342	23.684	0.212
UER	-0.974	7.358	-0.130	0.895	-15.396	13.448	0.464
NOR	-0.938	9.363	-0.100	0.920	-19.290	17.413	0.324
AGE	0.010	0.004	2.340	0.019	0.002	0.018	47.659
MRS	-0.008	0.133	-0.060	0.954	-0.268	0.252	0.743
EDU	0.151	0.136	1.110	0.268	-0.116	0.417	0.821
FBO	0.687	0.064	10.760	0.000	0.562	0.812	0.682
DTF	0.022	0.028	0.790	0.428	-0.032	0.076	2.404
CRD	0.148	0.129	1.150	0.249	-0.104	0.401	0.453
EXT	0.057	0.036	1.590	0.113	-0.013	0.126	2.229
FSZ	0.005	0.025	0.190	0.851	-0.045	0.054	3.237
PEC	0.257	0.110	2.330	0.020	0.041	0.474	0.212
SLB	0.065	0.189	0.340	0.731	-0.306	0.435	0.084

dy/dx is for discrete change of dummy variable from 0 to 1

The results of the probit regression for males are reported in Table 8 and Table 9. While Table 8 provides the coefficients, Table 9 shows the marginal effects. Unlike the females

(3 variables), 7 of the independent variables are statistically significant for males. The R^2 value of 0.488 (Table 12) shows about 48.8% of the observed variations in the dependent variable are explained by the independent variables. The statistically significant variables are MRS (*p<0.05*), EDU (*p<0.1*), FBO (*p<0.01*), DTF (*p<0.1*), CRD (*p<0.05*), EXT (*p<0.01*), and PEC (*p<0.01*).

Table 8: Probit regression results (males)

IDV	Coefficient.	St. Err.	t-value	p-value	[95% Confidence	Interval]	Sig
UWR	0.707	1.070	0.66	0.509	-1.390	2.804	
UER	0.212	1.061	0.20	0.842	-1.867	2.291	
NOR	-0.161	1.075	-0.15	0.881	-2.267	1.945	
AGE	0.012	0.007	1.57	0.117	-0.003	0.026	
MRS	-1.064	0.483	-2.20	0.028	-2.011	-0.116	**
EDU	0.479	0.263	1.82	0.068	-0.036	0.995	*
FBO	1.919	0.232	8.25	0.000	1.463	2.374	***
DTF	0.127	0.071	1.78	0.074	-0.012	0.267	*
CRD	0.701	0.295	2.38	0.018	0.122	1.279	**
EXT	0.171	0.063	2.70	0.007	0.047	0.295	***
FSZ	0.024	0.026	0.92	0.359	-0.027	0.075	
PEC	0.891	0.319	2.79	0.005	0.265	1.516	***
SLB	0.344	0.403	0.85	0.394	-0.447	1.135	
Constant	-2.400	1.251	-1.92	0.055	-4.851	0.051	*

Mean dependent variable	0.502	SD dependent variable	0.501
Pseudo r-squared	0.500	Number of objects	281.000
Chi-square	194.618	Probability > Chi^2	0.000

Akaike crit. (AIC)	222.927	Bayesian crit. (BIC)	273.864
*** $p<0.01$, ** $p<0.05$, * $p<0.1$			

Like the females, MRS has a negative relationship with technologies adoption decision. Among males MRS produced a marginal value of -0.37, suggestion that given a man is married the probability of adoption decreases by 37%. Discussion with farmers during the report dissemination exercise (pictures attached) revealed that couples have additional marital duties which may conflict with the time of training at the technology parks thereby limiting their participation in the training consequently adoption of the technologies. EDU reported a marginal value of 0.19, implying that given the man has no education the likelihood of adoption may increase by no more than one-fifth (19%). But since majority (75.1% for male and 85.6 for females) of the farmers have no formal education it will therefore be important to provide regular onsite training to continually upgrade their level of knowledge and practices in the given technologies. Like the females, the probability of adoption is also improved by 65% (marginal value=0.65) given the farmer is a member of a farmers' group. The study's a prior expectation was that an increase in distance to a farm of the farmer could decrease adoption decision because the farmer would have to go to his or her farm to perform other farm operations which could conflict with training and knowledge sharing time at the technology park. However, the study observed a positive and statistically significant relation between adoption decision and distance to farms. It reported a marginal value of 0.05, suggesting an increase in distance from the farmers' residence to farm increases the probability of adoption by 5%.

Marginal effects after probit

y = Pr(BEN) (predict)

= .48785063

Table 9: Marginal effects of probit results

IDV	dy/dx	Std.Err.	z	P>z	[	95%	C.I.
UWR	0.276	0.400	0.690	0.491	-0.509	1.061	0.423
UER	0.084	0.420	0.200	0.841	-0.738	0.907	0.199
NOR	-0.064	0.426	-0.150	0.880	-0.900	0.771	0.377
AGE	0.005	0.003	1.570	0.117	-0.001	0.010	45.900

MRS	-0.371	0.126	-2.950	0.003	-0.618	-0.124	0.943
EDU	0.187	0.099	1.900	0.058	-0.006	0.380	0.772
FBO	0.653	0.056	11.640	0.000	0.543	0.763	0.587
DTF	0.051	0.028	1.790	0.074	-0.005	0.106	1.862
CRD	0.268	0.103	2.600	0.009	0.066	0.470	0.153
EXT	0.068	0.025	2.700	0.007	0.019	0.118	2.253
FSZ	0.010	0.010	0.920	0.359	-0.011	0.030	6.126
PEC	0.334	0.103	3.240	0.001	0.132	0.536	0.185
SLB	0.136	0.155	0.880	0.381	-0.168	0.439	0.068

dy/dx is for discrete change of dummy variable from 0 to 1

Access to credit support (CRD) increases that probability of adoption by 27% (marginal value=0.27). Similarly, number of agricultural extension visit (EXT) and perception of ease of adoption (PEC) of the given technologies increase the probability of adoption by 7% (marginal value= 0.07) and 33% (marginal value= 0.33%) respectively. SLB, AGE, FSZ, regional dummies (UWR, UER) promote SIPs adoption positively, although, not statistically significant. It is only MRS and NOR that have negative relationship with adoption decision.

Comparism of SIPs Adoption Decisions of males and females

In summary three (3) factors influence SIPs adoption decision of female farmers. These are AGE, FBO membership and PEC. On the other hand, seven (7) factors influence the SIPs adoption decision positively of male farmers. These are EDU, FBO membership, DTF, CRD, EXT and PEC. FBO membership and PEC affect both male and female farmers positively. One of the cardinal reasons of the study is determine if the same or similar factors influence the adoption decision of both male female farm households since most studies have relied on pooled data to conduct analysis on SIPs adoption decision, neglecting the gender difference among males and females. Such finding are unlikely to inform policy to address farm holds' specific needs, hence the need for gender disaggregated analysis. In the disaggregated analysis it is important to observe that group membership or belonging to a farmer based organisation (FBO) and ease of adopting the technologies (PEC) are the only factors that promote technologies adoption among both males and females. As noted early on there are factors that promote female adoption but

same cannot be said for males and vice versa. This implies specific local needs and challenges must be critically considered in technology deployment. For instance is the technology easily accessible if project ends? Are there monetary resources needed to implement such technologies and are farmers resourced to purchase such supporting services on their own? Are there local technologies that can incooperated into the technologies to be deployed to promote ease of adoption etc.

To the above issues, it was observed during the dissemination exercise that some of the technologies deployed, for example, planting in rows and placing fertilizer into the soil were slow and labour demanding because farmers were using human labour. This tends to reverse adoption. Farmers proposed the development of simple multi-purpose machines that can help to mechanise these operation to minimise human labour. It was also realised that to fully implement the technologies and obtain the optimum yields farmers were required to apply specified amount of fertilizers at specified times. This involve monetary resources which farmers reported are hard to come by. Even if state subsidized fertilizers are supplied, allocation to farmers is insufficient, come in late, and distributed on discriminatory bases, by ones political affiliation. This challenge hinders technology adoption and optimum production. Farmers do not have access to formal financial institutions to provide loans therefore they rely on VSLS, which amounts obtained are way below the financial needs of farmers. On the use of local technologies and resources that can be incorporated to improve adoption among farmers, it was observed that farmers have access to organic fertilizers, mainly from animal manure and compost, but these are rarely used because farmers indicated it bulky and difficult to transport, difficult to decompose, and come with repugnant smell. These attributes of the locally available resource discourages it use. In bigger cities there are companies that recycle waste to produce organic fertilizers but farmers in rural areas do not have access to it. In few of the communities that have access to these refined organic fertilizers, farmers still complain of the slow rate of decomposition and absorption of the organic fertilizers. The dissemination team was shown a shop full of unpurchased organic fertilizers by farmers because of this challenge.

Group membership promote social equity, networking, peer learning and help share of successes and failures (if any). Group members can be encouraged by this to adopt a collective decisions of the group, knowing that failures and successes are shared together by group members. MRS, EDU, DTF, and EXT are statistically significant factors influencing adoption among male farmers, but same cannot be observed for the females. In like manner while AGE, is statistically significant factor influencing adoption among females, but same cannot witnessed for the males

MRS have negative relationship with adoption decision in both male and female regression models. This means that once an individual contracts a marriage, and/or begins to have children then the probability of adoption of the technologies begins to decline. Technologies adoption is found to improve productivity, income and welfare and couples (with or without children) may require monetary resources even more, so the need for such families to adopt technologies cannot be overemphasised. During discussion at the dissemination exercise it was observed that their relatively non adoption is because of lack of time to participate in such interventions because they have other responsibilities to perform. For instance, increased domestic chores could take away once time, taking up extra income generating activities to pay for the bills of household members. There is therefore the need for a concerted effort to educate couples on time and home management, so that they can allocate some times to participate in the trainings.

Biophysical and Economic Representative Technological Pathways For Farmers

IITA Technologies of interest included

1. Maize – cowpea intercrop
2. Maize – leaf stripping

3. Groundnut spacing technology

Cowpea living mulch technology

Biophysical	
Quantity of Seeds	9 kg/acre of maize and 9 kg/acre of cowpea
Quantity of Fertilizers	2bags (50kg) NPK + 1 bag Sulphate of ammonia
Quantity of Pesticides	100-400 ml/acre for cowpea
Quantity of Weedicides	400 ml/acre
Economic	
Ploughing Cost	GHC 85 kg/acre
Planting cost	GHC 80/acre for maize and cowpea
Harvesting Cost	GHC 80/acre
Spraying Cost	GHC 20/acre
Storage cost	GHC 0.50/100kg/Month
Quantity of produce harvest per acre	3-8 bags (100 kg) of cowpea/acre
Price per kg of produce	GHC 1.4/kg

Maize Leaf Stripping Technology

Biophysical	**Quantity/Amount**
Quantity of Seeds	9 kg/acre of maize

Biophysical	**Quantity/Amount**
Quantity of Fertilizers	2bags (50kg) NPK + 1 bag Sulphate of ammonia
Quantity of Weedicides	400 ml/acre
Economic	
Ploughing Cost	GHC 85 kg/acre
Planting cost	GHC 50/acre
Harvesting Cost	GHC 80/acre
Spraying Cost	GHC 20/acre
Storage cost	GHC 0.50/100kg/Month
Quantity of produce harvest per acre	3-7 bags (100 kg) bags of maize per acre
Price per kg of produce	GHC 1.4/kg

Groundnut Spacing

Biophysical	
Quantity of Seeds	15 kg/acre of groundnut (shelled)
Quantity of Fertilizers	12 kg TSP/acre
Quantity of Weedicides	400 ml/acre
Economic	
Ploughing Cost	GHC 85 kg/acre
Planting cost	GHC 80/acre
Harvesting Cost	GHC 145/acre
Spraying Cost	GHC 20/acre
Storage cost	GHC 0.50/ 80kg/Month

Biophysical	
Quantity of produce harvest per acre	2-10 bags (80 kg) bags of unshelled groundnut
Price per kg of produce	GHC 5.2/kg unshelled groundnut

Highlight SI indicators and their defining metric

*Economic**:*** Production costs, income (on-farm and off-farm), net revenues/losses at the farm/ household level.

Productivity: Yield (kg/acre) from adapted crop technologies at the farm/ household level.

Social cohesion- Participation in technology practice activities, collective action at the community level on adoption of technologies demonstrated.

Human- Capacity to households to adopt the technologies (number of farmers adopting the validated technologies, access to extension services).

Environment- the effect of crop-livestock technologies adopted on ecological processes at the farm and household levels, active ingredients level applied per acre (pesticides and fertilizers).

B.6. Synthesis

Use the SI indicator results to illustrate how outputs under the 4 outcomes are defining your innovation/technology.

B.7. Capacity Building

Tabulate: Type/title of training, where, when, number and category of people trained

Section C. Problems/challenges and measures taken

Section D. Partnership/linkages with other projects

CSIR-STEPRI collaborates with the Centre for Agriculture and Bioscience Information (CABI) leading the learning alliance and knowledge sharing component of the Sustainable Agriculture Intensification Research and Learning Alliance (SAIRLA) Programme in Ghana. This activity is also directly linked to two other sub-activities being implemented under the Africa RISING program as it draws on the crops/productivity work being done by IITA. The findings will certainly enrich policy discussions on technology adoption and generate more support from policymakers.

Section E. Lessons learned

N/A

Section F. Monitoring and Evaluation

N/A

F.1. Feed the Future indicators

Tabulation with the following columns: (i) FtF indicator, (ii) Annual target (iii) Progress toward target, (iv) Segregation, (v) explanation for over/under achievement (only for full report)

Info must also be provided to the Africa RISING Economist and/or to the project M&E specialist when needed for reporting to USAID FTFMS (usually during October each year) using PMMT.

F.2. Custom indicators

Tabulate (i) Custom indicator, (ii) Annual target, (iii) Progress toward target, (iii) explanation for over/under achievement

Table 2: Custom Indicators for Output 4.1

Custom Indicators For Output 4.1	Annual Target	Progress toward target	Explanation for over/under achievement
1. Number of AR project reports	2	Interim report written and submitted.	
2. Number of community engagements	16	All sixteen communities were reached for effective dissemination	
3. Number of Posters, policy briefs, and leaflets	4	Policy briefs are currently under review and would be published soon	

Section G. Success stories (in Pictures)

Dissemination exercise with farmers at Tingoli Community – Tolon District

Dissemination exercise with farmers at Cheyohi Community – Kumbugu District

Dissemination exercise with farmers at Kpachi Community – Kumbugu District

Dissemination exercise with farmers at Moglaa Community – Savelugu District

Dissemination exercise with farmers at Langa Community – Savelugu District

Dissemination exercise with farmers at Kpendua Community – Savelugu District

Dissemination exercise with farmers at Tibali Community - Savelugu District

Dissemination exercise with farmers at Nantanga Community – Bongo District

Dissemination exercise with farmers at Sambolugo Community – Bongo District

Dissemination exercise with farmers at Nyangua Community – Kasena Nankana District

Dissemination exercise with farmers at Gia Community – Kasena Nankana District

Dissemination exercise with farmers at Duosi Community – Wa West District

Dissemination exercise with farmers at Zanko Community – Wa West District

Dissemination exercise with farmers at Guo Community – Wa West District

Dissemination exercise with farmers at Nator Community – Nadoli-Kaleo District

Dissemination exercise with farmers at Goli Community – Nadoli-Kaleo District

Appendix

References