Quantitative Assessment of Farmers' Ratings of Technology Characteristics and Determinants of Adoption

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1. Introduction

Rice is the staple of the Senegalese with aggregate consumption 1,450,000MT, annual domestic milled production averaging 350,000MT and import 1,100,000MT in 2014/15; per capita consumption 73 to 93 kg. and a production-consumption gap at a self-sufficiency ratio of 20%. Senegal targets 40-50% self-sufficiency by 2020.This demands reversed increased attention towards post-harvest dimensions and greater commercial viability and competitiveness of the rice value chain (Wolfe et al 2009). ASI is an improved rice thresher technology developed to adapt to West African conditions by International Rice Research Institute (IRRI). The name 'ASI' is the acronym of *'ADRAO`* (French acronym of Africa- Rice Center); 'SAED' (Société d'aménagement et d'exploration des terres du delta du fleuve Sénégal}, and 'ISRA' (Institut sénégalais de recherches agricoles). They collaborated to develop ASI to match the local African conditions and needs.

ASI was purposely released in 1997 in Senegal aimed at improving rice quality and productivity and to alleviate the burgeoning high labor-demanding, post-harvest work which was already too much for women who were the main threshing labor. By vividly achieving this major goal, ASI won the special President of Senegal Prize for Science Research (2002 edition) in 2003. ASI has been demonstrated to possess high technical performance and financial profitability. Africa Rice research findings showed that Senegal River Valley (SRV) pedals on the coexistence of rice and vegetable growing that leads to frequent shortage of labor during rice harvest and post-harvest periods. The high emphasis placed on ASI in Senegal is on the fact that it releases rice labor to enable farmers work on their vegetable crop farms. Pilot survey shows that farmers perceived ASI thresher as time saving (saves 7 to 9 man-days per hectare), high grain recovery and moderate labor saving device. Variations of ASI have been released in Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Ghana, Mali, Mauritania and most recently, Nigeria. Despite all these, significant proportion of the producers in Senegal are still to adopt the technology while some adopters have discontinued the use. As the producer hold the indigenous knowledge, empirical confirmation of the claims of the high productivity of ASI is better viewed through the lenses of the end user producers. This study adopts the approach used in Norman et al., (1995) and Sall et al., (2000) to inculcate the farmers' wants into the technology development process.

2. Methodology Data and Sampling

Data is collected using well structured questionnaires on irrigated rice farmers of St Louis in the Senegal River Valley (SRV) in 2016. The questionnaire covered information on the farmer and farm characteristics; the technology specific characteristics that inform its demand and supply and; Farmers' subjective inclinations and input accessibility.

Purposive multi-stage sampling technique was used to select 320 rice farmers in St Louis Africa- rice Hub A total of 32 villages of 16 equal ASI adopters and non-adopters was covered. In the process, 10 households were randomly selected from the list of rice farmers provided by the farmers' groups. Overall, 320 respondents were used for the analysis.

2.1 Empirical Procedure

The sample includes rice farmers using traditional and improved threshing technologies. Adopters are those who have used ASI at least once between 2012-2015. Intensity of use of the technologies is the number of times farmer used ASI technology divided by the total number of rice production seasons from 2012 to 2015. In St Louis rice is cultivated 2 seasons per year (dry and weight seasons) giving 8 seasons.

Three threshing technologies used in the area are: (i) traditional (ii) ASI (iii) Combined harvester. ASI is more common used. The ASI adoption decision is based on the expected profit framework (Dimara and Skuras, 2003), where adoption occurs if expected profit from ASI adoption exceeds the prevalent profit level for traditional users (Burnham et. *al*., 1999). The decision to use ASI may be discreet while the decision to continue or discontinue is continuous. Probit regression model estimates the determinants of the probability to adopt while Tobit model estimates the determinants of the intensity of use (Wiredu et al., 2015).

Two major analytical approaches were used: These are

1. Use of index that fixes in farmers' ranking of the characteristics of ASI technology and;
2. Regression analyses to estimate the determinants that respectively influencing the decision to adopt and continue the use of ASI.

2.2 Salls indexing approach with the application of quasi-arbitrary ordinal weights

The quasi-arbitrary ordinal weighting indexing approach was used to evaluate the rating of the rice farmers on ten characteristics of three different threshing technologies. These include manual or traditional technology, ASI thresher cleaner and combined harvester cleaner. The technologies were described as shown in Table 1:

Table 1: Technology characteristics for indexing

Descriptive terms of Technology	Weighting Factor indices
Output	grain recovery rate, grain purity, and grain breakage rate
Resource use	labor use rate, threshing capacity, cost effectiveness
Machine specific characteristics	time saving, labor saving, Processing capacity
Supply terms	Accessibility, availability, Affordability

Demand indices (Table 2) in a nutshell identified characteristics of importance or the farmer expressed reasons why he would continue using the technology after having tested it. The indices provided the degree of importance that farmers attached to the identified technology specific characteristics, the quality of the characteristic exhibited in the technology and the satisfaction attained by using the technology. Three corresponding indices estimated with this model are demand, supply and attainment indices. The attainment index indicates how well a technology's characteristics meet farmers' preferences. Farmers were required to judge each attribute along two scales: (i) what is the importance of the attribute to them? (Very important=1, important=2, not so important-3) and (ii) how do they grade the quality of service rendered by the technology (high=1, moderate=2, low=3). For N farmers, each ranking the characteristics according to their importance and quality of service, the response matrix is as: shown in Equation 1:

Table 2: Table of two scales of judgment of attributes of technology

	Very important	Important	Not so important	Row total
High	n_{11}	n_{12}	n_{13}	r_1
Moderate	n_{21}	n_{22}	n_{23}	r_2
Low	n_{31}	n_{32}	n_{33}	r_3
Column total	c_1	c_1	c_1	N

But $\sum c_i = \sum r_i = \sum\sum n_{ij} = N$ (1)

Where

n_{ij}, = Number of farmers rating the technology importance, j, and their satisfaction i with the service provided ; cj, and r_i = Total number of farmers who ranked the characteristics according to its importance. and levels of satisfaction respectively

In the weighting Indices (Table 3):

s_i = row weights or the weights assigned to the farmers' assessment of how well a specific attribute is being exhibited in a given technology.

d_j = bottom row or demand weights assigned to the farmers' assessment of how important the specific attribute is.

Each cell in the matrix is derived as:

$w_{ij} = s_i d_j$

The propositions tested were:

(i) Regardless of the level of importance of a characteristic, the more favorable the farmer rates it embedded in the technology, the higher is the weight.

$w_{1j} > w_{2j} > w_{3j} > 0\dots\dots$ j

(ii) Weights for characteristics rated as high or higher in a technology should be positive and increase in value as the level of importance increases

$w_{i1} > w_{i2} > w_{i3} > 0 \quad \dots \quad \dots j$

(iii) When a characteristic is rated as low the weight should be negative and decreases as its importance rises

$w_{i1} < w_{i2} < w_{i3} < 0$

Table 3: Weighting Matrix

	Very important	Important	Not important	Supply weight s_i
High	w_{11}	w_{12}	w_{13}	s_1
Moderate	w_{21}	w_{22}	w_{23}	s_2
Low	w_{31}	w_{32}	w_{33}	s_3
Demand weight d_i	d_1	d_2	d_3	

2.3 Estimating determinants of adoption and the intensity of use

Farmer's decision to use ASI is complex and can be modeled as consisting of mutually exclusive decision to adopt and decision on intensity of use of the technology. The farmer views the threshing technology as a complex entity having diverse important attributes in adoption process. The final choice made in adoption is therefore the comparative outcome of all other threshing technologies known to the farmer. Hence our adoption model inculcates the unobservable inter-technology characteristics.

We adopt Tobit model (Tobiin, 1958) because of the appropriateness for studying decision in situation where the dependent variable is censored. Concisely, a Tobit model describes the relationship between a non-negative dependent variable y and an independent variable x (or vector). Tobit model supposes that there is a latent (unobservable) variabley^*. The variable y^* linearly depends on x through a parameter vectorβ. The parameter determines the relationship between x and y^*. There is the error term, μ, which is normally distributed. It captures random influences in the relationship. The Tobit model is implicitly stated as in Equation 7 (Sall et al., 2000)

$$y = E(y|y* > 0) = x\beta + \mu \qquad 7$$

Two types of effect can be identified for each independent variable in a Tobit variable:

$$y = \begin{cases} y* & if\ y*>0 \\ 0 & if\ y*\leq 0 \end{cases}$$

Where the latent variable $y*$ = βx + ε, $\varepsilon \sim$ N(0, σ^2)

We adopt Probit for determining the adoption because of its appropriateness for studying decision in situation where the error terms are truncated (Sall et al., 2000). In Probit model (Equation 8), z identifies ASI adoption (z=1, adopters and z=0, non-adopters); z*, latent variable for probability of adoption; x, set of explanatory variables; γ, set of coefficients of the explanatory variables; ε, error term.

$$z = prob(z|z*>0) = x\gamma + \varepsilon \qquad 8$$

2.3.1. Variables specification for determinants of Intensity of use of ASI.

$$Y = \frac{\text{No of times farmer threshed with ASI within the years under consideration}}{2N}$$

N= Number of years under consideration (2012 to 2015 or 4yrs); Intensity ranged from 0 to 1

The explanatory variables are specified as:

X_1= Years of group membership,

X_2= ASI accessible in the village (Dummy: Yes=1 and No=0)

X_3= Average age of economically active persons

X_4= Adopt of ASI (Dummy: Yes=1, No=0)

X_5= Sex (Dummy: Male=1, Female =0)
X_6= Adopt combine harvester (Dummy: Yes=1, No=0)
X_7= Have easy access to ASI (Dummy: Yes=1, No=0)
X_8= Citizenship (Dummy: Native =1; Stranger=0)
Because the Tobit coefficient represents the mean value for cases within and above the limit, they should not be treated as direct effects of the independent variable. A post estimation is needed for the coefficient to be decomposed (McDonald and Moffit, 1980 and Sall et al., 2000).

2.3.1. Variables specification for determinants of ASI Adoption

In a nutshell determinants of ASI adoption has been theoretically classified into socio-economic factors, demographic factors, farmer rating of the technology or subjective factors (Zhou et al., 2010) and access factors (Cavane, 2011). These guided the choice of explanatory variables for the model in our study.

The variable specification for Probit model was:

Z= 1 if farmer adopted ASI; and 0, otherwise
z* = latent variable for the probability of adoption
x= explanatory variables that influenced decision to adopt
γ= coefficients of the explanatory variables
ε= error term
In our specifications,
z_1= age of household head
z_2 = type of association which a farmer belongs
The explanatory variables X are specified as:
X_1= Membership in group (Dummy)
X_2= farmer rating ASI accessible
X_3= Tribe (Wolof=1),
X_4= farmer rating ASI available
X_5= Sex of household head
X_6= farmer participated in off-farm activity
X_7= Distance to technology (m),
X_8= farmer adopted combine harvester (Dummy: Yes=1, No=0)
X_9= Total revenue,(Kg/ha)),
X_{10}= Rice income (CFA),
X_{11}= Household size
ε = error term.

3.3.2 Marginal Effect

Marginal effect was estimated as a post-estimation for Probit regression. The marginal effect parameters measure the effects that a change in each explanatory variable has on the predicted likelihood of the farmer to decide to adopt ASI. The coefficients of the explanatory variables for the Probit regression cannot be directly interpreted because it

has no linear relationship with the outcome parameter. Each variable is treated individually while other variables are kept constant. However, each estimated coefficient can be expressed as a percentage.
The conditional mean function $E(y|\ x\ ) \ =\ \ F(\beta'\ x\ )$
Hence the probability that a farmer will decide to adopt: $Pr\ (y = 1)\ =\ F\ (\beta'\ x)$ is given as a derivative:
$(\partial E(y|x))/\partial x \ = [(\ \partial F\ (\beta' x)/\partial \beta' x]\ \beta$
F= Cumulative distribution function
β = coefficients of the parameters

3 Results

Using equations 1&2 a set of arbitrary weights were used to calculate the indices. The robustness of these results has been verified in Sall et al., (2000.) What the users of the various technologies want in terms of the specific technological characteristics is reflected in the demand indices given in Table 1. There is clear consistency in the specificity of the wants of the users with respect to the characteristics.

$S \longrightarrow S_1 > S_2 > 0 > S_3 \ = \ 15,\ \ 10,\ \ -4$ (1)

$D \longrightarrow d_1 > d_2 > d_3 > 0 = \ 10,\ \ 7,\ \ 4$ (2)

Arbitrary Sets

$s_1 d_1$	$s_1 d_2$	$s_1 d_3$
$s_2 d_1$	$s_2 d_2$	$s_1 d_3$
$s_3 d_1$	$s_3 d_2$	$s_3 d_3$
S_1	S_2	S_3

→

$15\ X\ 10$	$15X7$	$15X4$	10
$10X10$	$10X7$	$10X4$	7
$-4X10$	$-4X7$	$-4X4$	4
15	10	-4	

→

150	105	60	10
100	70	40	7
-40	-28	-16	4
15	10	-4	

3.1 Demand Indices

Table 4 shows that of topmost importance to the producers are labor saving and time saving. With time saved farmers could finish threshing own rice and still have time to be hired out to earn more income and attend to other economic or social activities. Timely threshing of rice enables the farmer to crop double seasons. It also enables good quality of rice as the harvested rice would be allowed to dry properly before threshing and the paddy adequately sundried before bagging. Again delay to harvest leads to risk of grain shattering on farm and rodent attack.

Also there is large number of farmers running after fewer machines. Saved labor is invariably reduced cost of production. In a nutshell, the demand indices show that farmers want a technology that will among other things save time and labor. The indices show the degrees of importance of these two factors and at the same time reflect the emphasis made on them. Specifically, female labor is of desperate importance for users of traditional technology. Female labor is mastery of traditional technology probably because it was the first rice threshing technology by the Senegal households. Moreover it is most appropriate for subsistence level of production where production is usually at very low scale. And in Senegal rice remains a staple uniquely served daily as lunch in every local household. For subsistence production, households could produce and process own rice with little or no need of external labor. Moreover the activities involved in the use of traditional technology do not demand heavy labor and can be done by women although labor drudgery may be a threat. Female labor use rate ranked last for the two mechanical technology users although with an appreciable degree of importance attached for ASI users.

With ASI, women labor is also required in rice harvesting, feeding of machine with straw and possibly double winnowing. Need for second winnowing increases as the machine parts wear and tear. The high demand for service of ASI impels owners to over use the machine. Particularly replacement of worn out parts is often delayed. For combined harvester where harvesting is automatic and feeding of machine is not needed, the only activity requiring female labor is double winnowing. This is often required because the technology is not well adapted to local rice varieties so that poor grain- straw separation may occur which demands women's labor for second winnowing. The low importance attached to female labor for users of combined harvesters reflects major concern. Inferentially, place of importance of female labor in rice threshing is gradually being displaced alongside advances in technology in Senegal. In fact the concern about the possibility of labor to thrive alongside with technology advances was reflected not only on the ranking of its importance attached but also in the low degree of demand attached by the users of the more advanced combined harvester technology.

Grain recovery rate is of high importance especially for both traditional and ASI users. Here grain loss may occur in two different instances: Rice is harvested manually where mal-handling of panicles may cause losses. Also grains are lost during the separation of grain from straw or threshing. Users of traditional technology and ASI would want a technology that could reduce grain losses at both subsistence and commercial scale. For combined harvester, 'the sieve plate' (medium through which grain is separated from the straw), is a follow-come complement which is most often unsuitable for the local varieties grown in Senegal. Surprisingly farmers reported incidences of high grain losses. They want a innovation technology to check such wastes.

The same emphasis has been laid on grain purity (straw separation). Mechanically, it is an arduous time consuming task. In Senegal this is mainly women task and women are always in pressure of time due to their roles in household, society and economic activities. Women want a technology to ease winnowing. Accessibility, Availability and affordability are the characteristics to define ease to acquire the service of the technology by farmers. And these are equally shown to be in high demand for all categories of technology users. The availability of the technology, service providers and skilled labor, the number of users pursuing the service of a technology at a given time, the service charge rate, the price and ease of access to technology compliments, etc are all encompassing. Other relevant technology specific attributes may include the complain by farmers that combine harvesters are too heavy and difficult to operate on water logged farms impairing the ease of use of the technology on wet clay soil characteristic of Dagana, the more fertile region of Senegal. The degree of emphasis indicated is suspected to reflect the scale of operation which inadvertently points down to the economic status of each category of users. Users of traditional and ASI may be subsistent and commercial but combined harvesters are purely for commercial purposes where production capitals may be less an impediment. Notice therefore slight variations in the degree of importance attached. Processing capacity is ranked in same level of wants for all farmers with higher degree of importance for combined harvesters consistently reflecting increasing commercialization. Expectedly cost effectiveness of technology is attached high importance and with distinct degree of importance for users of combined harvester. This may equally be business informed.

The least in the rank of the traditional users is Grain quality. By this we refer to the percentage of broken grain, the absence of odour and impurities (e.g stone, sand, pebbles, and animal droppings).This may be explained by the high subsistence production level characteristic of the technology. Good number of the farmers produce for consumption and are not driven by market demand. The broken rice may be used for traditional dishes and are appreciated by the local households. However the 0.66 degrees of importance still shows that grain quality is considered by a simple majority as important characteristics. Consistently higher degrees of importance have been indicated for grain quality by the users of mechanical technology. The quality determines the market value. Vividly the responses from the mechanical users tilt more towards market orientation than the traditional users. The range of 0.86 to 0.99 demand indices obtained for all the characteristics in consideration for the three technologies shows that the characteristics under consideration capture the dire want of the users in a rice threshing technology.

Table 4: Demand Index

Traditional technology		ASI Technology		Combined harvester technology	
Characteristics		**Characteristics**		**Characteristics**	
Labor saving	0.99	Time saving	0.94	Labor saving	0.99
Time saving	0.97	Grain quality	0.93	Time saving	0.97
Female labor use rate	0.97	Availability	0.92	Grain purity (straw separation)	0.97
Grain recovery rate	0.95	Labor saving	0.92	Cost effectiveness	0.97
Grain purity (straw separation)	0.95	Affordability	0.91	Grain quality	0.96
Accessibility	0.90	Grain recovery rate	0.89	Grain recovery rate	0.93
Availability	0.89	Grain purity (straw separation)	0.89	Availability	0.93
Processing capacity	0.88	Processing capacity	0.87	Processing capacity	0.91
Affordability	0.88	Accessibility	0.87	Accessibility	0.88
Cost effectiveness	0.88	Cost effectiveness	0.86	Affordability	0.86
Grain quality	0.66	. Female labor use rate	0.72	Female labor use rate	0.58

3.2 Supply Indices

As depicted (Table 5) apart from the criterion relating to grain recovery rate, the characteristics were, according to farmers being better supplied with respect to ASI rather than combined harvester. This is not surprising given the more flexibility of the ASI technology that is the ability of the ASI to be used in all weather conditions. The ASI technology is fabricated locally by local fabricators to adapt to local environment more over it is comparatively cheaper (2.5 Million FCFA) than combine (40million FCFA) and its spare parts are locally available. The technology is suitable for low, medium and large scale production. Because of this the issue of acquiring (affordability, accessibility and availability) the service of ASI may not be critical as in the case of combined harvester. In terms of individual criteria, the result indicates that farmers in general rank the mechanical technologies as supplying the time saving, labor saving, grain purity (straw-separation), cost effectiveness and processing capacity criteria better than the traditional technology. These are not surprising since these are the major criteria that drive the market value of paddy. Unsurprisingly too, the female labor use rate appears to be supplied by all except the combined harvester. The biggest surprise in the result is the acclaimed short supply of the criterion of grain quality by ASI technology. This is not very clear considering the field observation of highly reduced grain breakage for ASI rice. This may need to be crosschecked.

Table 5: Supply Index

Characteristics	Traditional tech	Characteristics	ASI	Characteristics	Combined
Grain recovery rate	1.00	Labor saving	0.88	Time saving	0.97
Grain quality	0.93	Time saving	0.87	Labor saving	0.94
Female labor use rate	0.81	Female labor use rate	0.87	Grain quality	0.91
Affordability	0.72	Grain recovery rate	0.87	Processing capacity	0.89
Availability	0.70	Grain purity (straw separation)	0.86	Grain recovery rate	0.82
Accessibility	0.67	Accessibility	0.86	Grain purity (straw separation)	0.79
Processing capacity	0.59	Availability	0.86	Cost effectiveness	0.79
Cost effectiveness	0.55	Processing capacity	0.80	Affordability	0.40
Grain purity (straw separation)	0.48	Affordability	0.77	Accessibility	0.27
Labor saving	0.12	Cost effectiveness	0.77	. Female labor use rate	0.08
Time saving	-0.02	Grain quality	0.54	Availability	0.04

3.3 The attainment index

The final index, Table 6, indicates the farmers' ranting as to how well their needs in terms of threshing are being supplied. The results confirm the observations made earlier those farmers' expectations are being better met with respect to ASI rather than combined harvester technology. In terms of individual criteria, farmers provided that the attainment level with respect to female labor use rate was very poor with a consistent difference between the traditional and mechanical. Obviously, there is an urgent need to address this in the stakeholders' forum. Remarkably, if the accessibility to the service of combined harvester and its female labor use rate is enhanced, combined harvester would be as much desired as ASI or even overtake ASI.

Table 6: Attainment Index

Traditional technology		ASI Technology		Combined Harvester Technology	
Characteristics		Characteristics		Characteristics	
Female labor use rate	0.80	Grain quality	0.83	Time saving	0.94
Grain quality	0.63	Time saving	0.82	Labor saving	0.93
Affordability	0.62	Labor saving	0.80	Grain quality	0.89
Availability	0.60	Grain recovery rate	0.79	Processing capacity	0.83
Accessibility	0.60	Grain purity (straw separation)	0.79	Grain recovery rate	0.77
Processing capacity	0.54	Processing capacity	0.77	Grain purity (straw separation)	0.76
Cost effectiveness	0.50	Cost effectiveness	0.76	Cost effectiveness	0.76
Grain recovery rate	0.35	Availability	0.73	Affordability	0.35
Grain purity (straw separation)	0.35	Affordability	0.70	Accessibility	0.27
Labor saving	0.11	Accessibility	0.70	Female labor use rate	0.15
Time saving	-0.03	Female labor use rate	0.40	Availability	0.04

3.4 Ascertaining determinants of adoption of ASI rice threshing technologies

Table 7 provides the intuitive hypothetic determining factors that influenced adoption of ASI. This was necessary to project our *a priori* expectation ahead of analysis.

Table 7: Hypothesized Determinants of Adoption of rice threshing technologies

Variable	Measure	H0 sign	Rationale
Farmer/Farm characteristics			
Age	Household head (Years)	-	Older persons less interested because cultural ties that lead to conservatism
Education level	Level of educational attainment	+	Education makes a person to open his mind to receive constructive ideas
Number of years of rice Farming	Years	+	This is a proxy for experience, experience viewed more favorably
Member of agricultural association	1=Yes; 0=No	+	Membership predisposes members to exposure to developmental initiatives and acquisition of input resources stimulating adoption
Nativity of Farmer	1=Native; 0=Stranger	-	Producers who migrate to settle for production must be business conscious and so would adopt improved technology for enhanced farm performance
Engage in off-farm activity	1=Yes; 0= No	+	Engaging in off-farm activities secures rice farming from shock and disposes the farmer to demand of time. It therefore encourages adoption of time saving technology
Region	1=Dagana; 0= Podor	+	There is higher concentration of ASI technology in Dagana than in Podor. This encourages adoption
Credit availability	1=yes; 0=No	+	Credit facilitates purchase of technology services
Farmers' perception about the improved threshing technology compared with the traditional			
Accessibility, affordability, availability, time –labor saving, grain recovery, rice purity and quality, capacity of production	1=very satisfactory 0=Not very satisfactory	+	Higher attributes viewed more favorably
female labor- use rate	1=very satisfactory 0=Not very satisfactory	-	Higher attributes viewed less favorably

The result (Table 8) shows that variables reflecting farmer/farm characteristics (five variables) and farmers' rating of the technology (two variables) were significantly important in deciding whether to adopt or not. The farmer/farm specific variables tilt towards education, environment, influence of substitute technology, engagement in supplementary economic activity. Good education help in understanding the innovativeness of a technology by enabling the user to grasp the dimensions of change derived from the use of it thereby influencing the adoption decision. Farmers' rating of the satisfaction drawn from the timesaving essence of the technology significantly influenced the increased adoption of the technology. As expected farmers' dissatisfaction shown in the rated low use-rate of female labor discourage the decision to adopt. Farmer engaging in off-farm economic activity is important latent variable in the adoption decision

Table 8: Factors determining the Adoption of ASI thresher technology

Adoption of ASI	Coefficient	Std. Error
Education level	0.316063***	0.116368
Region (Dagana=1, Podor=0)	0.75955***	0.259875
Rate of use of female labor	-0.69793***	0.200676
Time saving attribute	0.326661*	0.191155
Adoption of combined harvester	-1.20186**	0.561936
Access to combine harvester	0.961403*	0.52392
Involve in off-farm activity	0.378992	0.251213
Constant	0.222259	0.208631

Results in Table 9 show that the decision on the intensity of use of ASI is favored by nativity of the farmer, duration in group membership, adoption of ASI and accessibility of the technology; and disfavored by adoption of combined harvester, increasing average age of economically active persons in the household and land-labor ratio

Table 9: Factors affecting the intensity of use of ASI thresher technology

Use Intensity of ASI Technology	Coefficient	Std. Err.
Adoption of combined harvester	-.5166792***	0.125157
Average age of economically active members of household	-.0154799**	0.007838
Land- labor- ratio	-.0000207**	1.04E-05
Adoption of ASI	.4443397***	0.144733
Nativity of farmer (Natives=1; strangers=0)	.8673138***	0.163016
Duration in group membership	-.0187331***	0.005493
Accessibility to technology in the village	.8262616***	0.150848
Constant	.3345593	0.28073
Sigma	.562342	0.063354

4.1 Conclusion:

Adoption incidence rate of ASI is 78% in SRV. The factors that encourage ASI adoption in SRV are education, farmer living in Dagana, and farmers' conviction that ASI saves time. The adoption is discouraged by farmers rating that ASI does not provide for increasing use of female labor, and farmers adopting combine harvester. Use of ASI is intensified by farmer adopting ASI, farmer being a native of the producing area, and farmer accessing technology in the village. On the contrary, adoption of close substitute technology; and increasing proportion of labor over area of rice grown discourage intensity of use.

At least 70% of the characteristics that the farmers expect are met in ASI except that farmers are still grudging that rate of female use is reduced (40%) compared with traditional (80%). This was even worse for combined harvester at 0.04%. Four characteristics are at minimal for traditional and combine harvester. The Farmers in SRV consistently want a threshing technology that is time and labor saving and reduce grain loss. Place of importance of female labor in rice threshing is gradually being displaced alongside advances in technology in SRV. The concern about the possibility of female rice labor to thrive alongside with technology advances was reflected on the ranking of importance and in the low degree of demand attached by users of combined harvester. Spread of ASI in West Africa heavily depends on the ability of stakeholders to make it accessible to farmers at village level. Indeed mechanical thresher provokes commercial viability of rice. The range of 0.86 to 0.99 demand indices obtained for all the characteristics except female labor use rate shows that the characteristics under consideration capture the dire wants of the respondents for all rice threshing technologies.

4.2 Recommendation

- The three most important Policy rudiments for promoting the adoption of ASI technology in SRV include setting incentives that would incite rice farmers' into gaining membership into farmer groups for strong social networking, promoting women involvement in rice cultivation and threshing activities, and providing incentives to attract more Wolof indigenes into rice production.
- The two frontline Policy domains to promote the resilience of ASI technology in SRV include making ASI accessible to farmers especially in the villages and providing incentives to induce Senegal citizens to join rice production.
- More so any intended innovation strategies by the stakeholders towards developing ASI should imbibe the characteristics indentified by the farmers in the demand, supply and attainment indices in this study.
- The vision 2020 for self sufficiency in rice can be met in Senegal and other rice producing regions of the sub-Saharan Africa if development agents ensure intensified use of ASI among other rice system development strategies.

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