CHAPTER V

FACTORS AFFECTING THE ADOPTION OF INM PRACTICES

This chapter presents empirical results of logit models determining probability of the adoption of INM practices under rice straw, paddy husk charcoal, farm yard manure and green manure application of the surveyed households, as well the marginal effects of independent variables in each model.

The binary responses with regards to the adoption (0 or 1) can be modeled with binary logit and probit regressions. In order to explain the behavior of this type of dichotomous dependent variable, logit model uses cumulative logistic function; but probit model uses the normal cumulative distribution function. But the results of logit analysis can be easily interpreted and method is simple to analyze (Bacha *et al*., 2001). Therefore logit model was used in this study to identify the factors affecting the adoption of different INM practices.

5.1 The adoption of rice straw application

This analysis was conducted in the light of identifying socio-economic, physical and institutional factors with related to the adoption of rice straw application.

5.1.1 Factors affecting the adoption of rice straw application

The dependent variable took the value of 1 if the household was incorporating rice straw with chemical fertilizers and 0 otherwise. Variables that were hypothesized to affect the adoption of rice straw application included characteristics of the household head such as age, level of education, membership in farmer organization, number of trainings participated on INM, number of extension contacts kept within a season and also his or her perceptions on INM adoption. In addition, it was also included some characteristics of the household such as land ownership, cultivated land extent, labor availability in the household and income from other sources and also method of harvesting and AgS division as a physical factor.

Land extent, age and AgS division were hypothesized to affect either positively or negatively. Types of land ownership were hypothesized to affect negatively, while the other independent variables in the model were hypothesized to affect positively to the probability of rice straw adoption.

The logistic regression model was applied to analyze the effects of these variables on households' adoption decisions to apply rice straw; and the result is presented in Table 5.1.

Table 5.1: Factors affecting the adoption of rice straw application

Variable	Co-efficient	Standard Error	t-ratio	Sig
Constant	-7.87	3.83	-2.06	0.04**
LAND	0.04	0.22	0.17	0.87
LD_OWN1	0.77	0.88	0.87	0.38
LD_OWN2	-1.12	1.54	-0.73	0.46
AGE	0.05	0.05	1.00	0.32
EDU	0.01	0.16	0.06	0.95
MEMSP	0.89	1.72	0.52	0.61
TRAIN	-0.23	0.21	-1.09	0.27
LABOR	0.18	0.36	0.49	0.62
INCOME	0.00	0.00	0.56	0.58
EXTEN	0.09	0.14	0.64	0.52
MTD_H	1.95	1.09	1.78	0.07*
PERCP	4.98	1.11	4.50	0.00***
AGS_D	0.49	1.23	0.39	0.69

Note: McFadden Pseudo R^{-2} 0.52 Chi squared 56.14 (df =13)

Log likelihood function -25.81 Restricted log likelihood -53.88

Prob [ChiSqd > value] = 0.00 LR statistics 56.14 (13df)

Probability (LR stat) 0.00 Sample 119

*, **, *** indicate the level of significance at 10%, 5% and 1% respectively

McFadden Pseudo R-squared was 0.52; and it revealed that 52% variation of the dependent variable could be explained by the model. The model was significant at 5% level of significance.

According to the results, perception of the household head and method of harvesting showed significant and positive impact on the adoption of rice straw application. These findings are in consistent with literature; and the finding with regards to perception is same as the findings of Yamota and Tan-Cruz (2007) and Chianu and Tsujii (2004). They revealed that farmers' perception towards the technology have a positive impact on its adoption. With mechanical harvesting; households have the opportunity to easily apply rice straw in their fields, compared to manual harvesting. Therefore the finding with regards to the harvesting method is in accordance with the findings of Sarwar and Goheer (2007); that any intervention in technology is acceptable only when it is easily applicable, economically viable as well as environmentally beneficial. Other factors hypothesized to influence the adoption didn't show significant impact on the adoption of rice straw application.

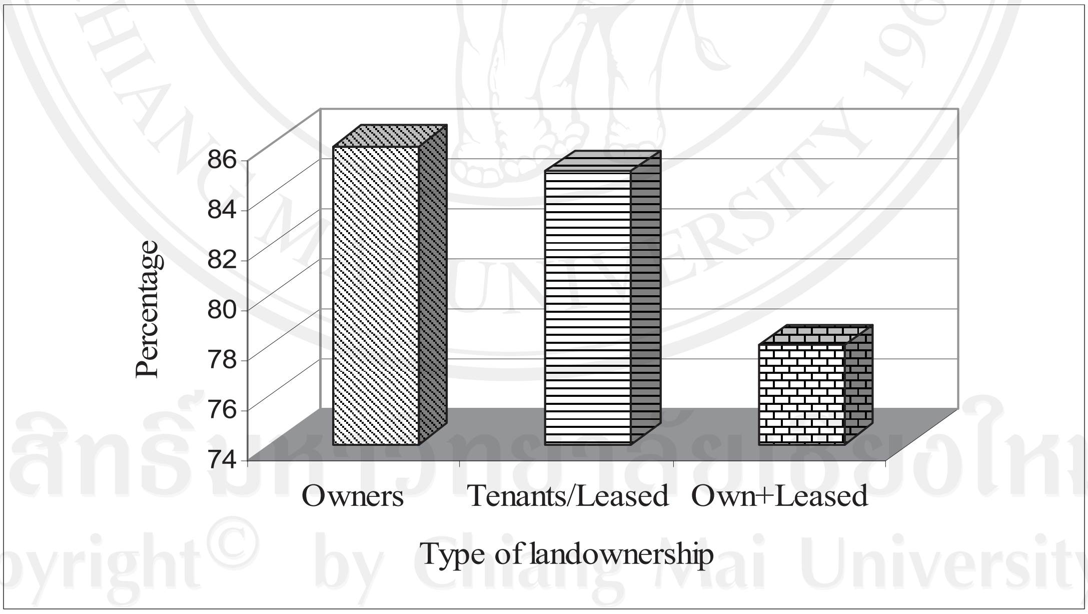

Figure 5.1: INM adoption with related to the type of land ownership in study area

The total cultivated land extent showed a positive effect on probability of the adoption of rice straw application. It means that increased land extent has motivated farmers to adopt; especially through mechanical harvesting. Normally, farmers who take land on tenure basis try to harvest high yields using mineral fertilizers and irrigation to ensure rapid returns and may ignore the use of organic manures especially in cereal crop production (Rao *et al*., 2006). But interestingly in this study, it could be noticed that LD_OWN1 having a positive effect on the adoption. Therefore it can be concluded that tenant or leased farmers were more willing to adopt rice straw application. This may be because as they were more pressurized to pay their rental for owners and also for their own consumption. So they may be trying to get a higher yield following this practice. LD_OWN2 showed a negative effect; which implied that the households cultivated in leased lands at the same time with their own, were less likely to adopt the practice than the owner farmers. A possible explanation is that they may be less pressurized with cultivating their own lands. The adoption behavior of these groups is shown in Figure 5.1.

Age and education level of the household head showed positive impacts on the probability of rice straw adoption. This implies that more educated and elder household heads were more inclined to adopt this practice. As a result of their long term experience in paddy cultivation, they may have identified the benefits of this application. This suggests that application of rice straw in paddy cultivation is probably no longer viewed as a "new" soil fertility management technology by them. Significantly higher number of surveyed households in Ambalantota AgS division was adopted in this practice than the households in Lunama AgS division. Significantly increased mechanical harvesting in Ambalantota, may stimulate its households to adopt this technology. The coefficient of TRAIN showed a negative relationship with the adoption probability; this implied less importance of training on households' rice straw adoption decision in study area. Only awareness through extension services may be enough for the adoption to spread rice straw throughout their field before ploughing. Relationships of the other variables in the model were as expected.

According to the results of logit model for the adoption of rice straw application; the cumulative logistic distribution function is;

$$F(Z) = \frac{e^Z}{1 + e^Z}$$

$$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

Z = -7.87 + (0.04* LAND) + (0.77* LD_OWN1) + (-1.12* LD_OWN2) + (0.05* AGE) + (0.01* EDU) + (0.89* MEMSP) + (-0.23* TRAIN) + (0.18* LABOR) + (0.00* INCOME) + (0.09* EXTEN) + (1.95* MTD_H) + (4.98* PERCP) + (0.49* AGS_D)

5.1.2 Marginal effects of independent variables on rice straw adoption

Marginal effects indicate the expected change in predicted probability of adopting rice straw for a unit change in an explanatory variable. Equation (6) can be used to estimate the effect of one control variable on probability of the response variable.

$$\Delta P = F\,[\beta_0 + \beta_1(x_1 + \Delta x_1) + \beta_2 x_2 + \ldots\ldots\ldots\ldots + \beta_k x_k]$$
$$- F\,(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_k x_k) \qquad (6)$$

Where ΔP represented the change in probability resulted by control variable x_1.

x_1 = LAND, LD_OWN1, LD_OWN2, AGE, EDU, MEMSP, TRAIN, LABOR, INCOME, EXTEN, MTD_H, PERCP, AGS_D

Marginal effects of the above model were analyzed to find the effect of individual variable on the adoption of rice straw application.

As noted in Table 5.2, it clearly indicated that, with 1% increase of mechanical harvesting, it tends to increase in the probability of the adoption of rice straw application by 18%; and with 1% increase of the household heads with positive perceptions on INM, it tends to increase it by 80%. This emphasizes the importance of the use of combine harvesters for harvesting process and also how affects farmers' positive perceptions with regards to the rice straw application practice. This result is consistent with what has been reported by Yamota and Tan-Cruz (2007), Wubeneh and Sanders (2006) and Kotu *et al*., (2000) in their studies of technology adoption. Based on these results it can be predicted that mechanical harvesting and positive perceptions of the household head may lead to increase the adoption of rice straw application in study area. According to Table 5.3 the total correct prediction of the above model is 92.4%, with correct predictions for the non adoption 10.9% and 81.5% for the adoption.

Table 5.2: Marginal effects of independent variables on rice straw adoption

Variable	Marginal effect	Variable	Marginal effect
Constant	-0.47	TRAIN	-0.0139
LAND	0.0021	LABOR	0.0106
LD_OWN1	0.0422	INCOME	0.0000
LD_OWN2	-0.1029	EXTEN	0.0053
AGE	0.0031	MTD_H	0.1828*
EDU	0.0005	PERCP	0.8016***
MEMSP	0.0748	AGS_D	0.03

Note: *, *** indicate the level of significance at 10% and 1% respectively

Table 5.3: Actual and predicted outcomes of the logit model for rice straw adoption

Actual value	Predicted value		Total actual
	0	1	
0	13 (10.9%)	7 (5.9%)	20 (16.8%)
1	2 (1.7%)	97 (81.5%)	99 (83.2%)
Total	15 (12.6%)	104 (87.4%)	119 (100.0%)

5.2 The adoption of paddy husk charcoal application

It is worth noting that, the probability of INM adoption was dominantly represented by the probability of rice straw application; and the results with regards to the other organic materials may not be the same. Therefore the purpose of this analysis was to identify the socio economic and institutional determinants that affect the adoption of paddy husk charcoal application in paddy cultivation. Table 5.4 presents logit estimates of the determinants on probability of its adoption.

5.2.1 Factors affecting the adoption of paddy husk charcoal application

The dependent variable took the value of 1 if the household was applying paddy husk charcoal with chemical fertilizers and 0 otherwise. Variables that were hypothesized to affect the adoption of paddy husk charcoal application included characteristics of the household head such as age, level of education, membership in farmer organization, number of trainings participated, number of extension contacts and perception on INM. It also included some characteristics of the household, such as land ownership, cultivated land extent, number of members coming under labor force and income from other sources and also method of harvesting and AgS division.

Land extent, AgS division and method of harvesting were hypothesized to affect either positively or negatively. Types of land ownership and age were hypothesized to affect negatively, while the other independent variables in the model were hypothesized to affect positively to the probability of rice straw adoption.

Table 5.4: Factors affecting the adoption of paddy husk charcoal application

Variable	Co-efficient	Standard Error	t-ratio	Sig
Constant	-35.62	0.13	0.00	1.00
LAND	0.28	0.17	1.64	0.10
LD_OWN1	-0.76	0.83	-0.92	0.36
LD_OWN2	-3.16	1.84	-1.71	0.09*
AGE	-0.03	0.04	-0.71	0.48
EDU	0.02	0.13	0.17	0.86
MEMSP	32.83	0.13	0.00	1.00
TRAIN	0.37	0.15	2.48	0.01**
LABOR	0.06	0.24	0.24	0.81
INCOME	0.26	0.33	0.80	0.42
EXTEN	0.10	0.08	1.31	0.19
MTD_H	-0.12	0.87	-0.13	0.89
PERCP	0.75	1.21	0.62	0.54
AGS_D	-1.14	0.92	-1.24	0.22

Note: McFadden Pseudo R^2 0.27 Chi squared 23.94 (df = 13)

Log likelihood function -33.11 Restricted log likelihood -45.08

Prob [ChiSqd > value] = 0.3173124E-01 LR statistics (13df) 23

Probability (LR stat) 0.03 Sample 119

*, ** indicate the level of significance at 10% and 5% respectively

McFadden Pseudo R-squared was 0.27; this indicated that 27% variation of the dependent variable could be explained by the model.

These findings were somewhat different than the findings of logit analysis in rice straw adoption. While LD_OWN2 was significantly and negatively affected; number of trainings attended by the household head was significantly and positively affected to the adoption of paddy husk charcoal application. LD_OWN1 also showed a negative relationship with the adoption. This showed that the households were much concentrated on the application of this type of rare organic materials in their own fields rather than in tenant or leased lands. According to Sanni and Doppler (2007); farmers tend to invest more in soil fertility management strategies if they own the land than when borrowed or rented. In line with this, results of this study showed that the owner households were more inclined to adopt in paddy husk charcoal application than the non owner households. Yamota and Tan-Cruz (2007) indicated number of trainings attended as a significant factor that affects the rate of technology adoption. It was confirmed by these results of the adoption of paddy husk charcoal application; because it needs farmers' skills for better performances in charcoal preparation and application. Survey data indicated that; only 33% of the adopted households were able to prepare the needed amount of charcoal by themselves.

On the other hand, the likelihood of applying paddy husk charcoal was found to be increased with the total land extent cultivated. This revealed that in large scale, the households were more inclined to spend their financial and labor resources on the equipments and also to produce charcoal. This may be because it provides better returns to the investment, as cost per unit area is less with compared to the small land extent. Meantime, age of the household head showed a negative relationship with the adoption. This is consistent with the findings of Damisa and Igonoh (2007) and Sanni and Doppler (2007). This negative impact might be attributed to the fact that; younger farmers were more willing to adopt, as it was a new technology. Furthermore, harvesting method showed a negative relationship with the probability of paddy husk charcoal adoption. This may be because with manual harvesting, households were more inclined to adopt charcoal application, as it leads to reduce the problem of lodging. Showing a negative relationship with the variable of AgS division, it gave the evidence for the above explanation as significantly higher use of manual harvesting in Lunama AgS division. Relationship of the other variables included in the model was as hypothesized at the beginning.

According to the results of logit model for the adoption of paddy husk charcoal application; the cumulative distribution function for the adoption is as follows,

$$F(Z) = \frac{e^{Z}}{1 + e^{Z}}$$

$$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

Z = -35.62+ (0.28* LAND) + (-0.76* LD_OWN1) + (-3.16* LD_OWN2) + (-0.03* AGE) + (0.02* EDU) + (32.83* MEMSP) + (0.37* TRAIN) + (0.06* LABOR) + (0.26* INCOME) + (0.10* EXTEN) + (-0.12* MTD_H) + (0.75* PERCP) + (-1.14* AGS_D)

5.2.2 Marginal effects of independent variables on paddy husk charcoal adoption

It will be helpful to identify the effects of individual explanatory variables on the adoption of paddy husk charcoal application for further improvements of this practice. Therefore results of the analyzed marginal effects for the above model are summarized in Table 5.5.

In interpreting these results, it is important to note that a 1% increase in the number of households who cultivate their own land at the same time with leased lands, and also a 1% increase of the number of households who cultivate as a tenant or leased; lead to reduce the probability of paddy husk charcoal adoption by 1%. But with 1% increase of number of trainings participated by the household head within two years, it may result 0.4 % increase of the probability of its adoption. Therefore it can be predicted that with household landownership and their ability to access trainings, it will lead to increase the adoption of paddy husk charcoal application in study area; and correctly prediction of this model is at 90.8 % according to the table 5.6. The total correct prediction for the non adoption is 86.6% and it is 4.2% for the adoption of paddy husk charcoal.

Table 5.5: Marginal effects of independent variables on paddy husk charcoal adoption

Variable	Marginal effect	Variable	Marginal effect
Constant	-0.35	TRAIN	0.0036**
LAND	0.0027	LABOR	0.0006
LD_OWN1	-0.0069	INCOME	0.0000
LD_OWN2	-0.0121*	EXTEN	0.0010
AGE	-0.0003	MTD_H	-0.0012
EDU	0.0002	PERCP	0.0058
MEMSP	0.0838	AGS_D	-0.01

Note: *, ** indicate the level of significance at 10% and 5% respectively

Table 5.6: Actual and predicted outcomes of the logit model on paddy husk charcoal adoption

Actual value	Predicted value		Total actual
	0	1	
0	103 (86.6%)	1 (0.8%)	104 (87.4%)
1	10 (8.4%)	5(4.2%)	15 (12.6%)
Total	113 (95%)	6 (5.0%)	119 (100.0%)

5.3 The adoption of farm yard manure application

5.3.1 Factors affecting the adoption of farm yard manure application

The decision to adopt farm yard manure application was hoped to be a function of factors such as socio economic and institutional. The dependent variable took the value of 1 if the household was applying farm yard manure with chemical fertilizers and 0 otherwise. Variables that were hypothesized to affect the adoption of farm yard manure application, included some characteristics of the household head such as age, level of education, membership in a farmer organization, number of trainings participated, number of extension contacts and perception on INM. It also included some characteristics of the household such as land ownership, cultivated land extent, labor force availability and income from other sources and also method of harvesting, and AgS division.

Land extent, land ownership and age of the household head were hypothesized to affect negatively to the probability of the adoption of farm yard manure. Method of harvesting and AgS division were hypothesized to affect either positively or negatively, while the other variables in the model were hypothesized to affect positively.

An empirical specification was employed to investigate the relationship between above factors and probability of the adoption of farm yard manure application (Table 5.7).

Table 5.7: Factors affecting the adoption of farm yard manure application

Variable	Co-efficient	Standard Error	t-ratio	Sig
Constant	-39.36	0.13	0.00	1.00
LAND	-0.11	0.23	-0.45	0.65
LD_OWN1	-0.83	1.05	-0.79	0.43
LD_OWN2	-2.43	2.02	-1.19	0.23
AGE	-0.07	0.05	-1.36	0.18
EDU	-0.04	0.15	-0.24	0.81
MEMSP	38.20	0.13	0.00	1.00
TRAIN	0.35	0.16	2.10	0.04**
LABOR	0.42	0.28	1.51	0.13
INCOME	0.67	0.44	1.52	0.13
EXTEN	0.19	0.08	2.23	0.03**
MTD_H	0.03	1.11	0.02	0.98
PERCP	0.32	1.40	0.23	0.82
AGS_D	-0.55	1.07	-0.52	0.61

Note: McFadden Pseudo R^2 0.37 Chi squared 30.11(df =13)

Log likelihood function -25.99 Restricted log likelihood -41.05

Prob [ChiSqd > value] = 0.4536978E-02 LR statistics (13df) 30

Probability (LR stat) 0.00 Sample 119

** indicate the level of significance at 5%

McFadden Pseudo R-squared was 0.37; indicated that the model could explain 37% of the relationship between the dependent variable and independent variables.

The logit model for probability of the adoption of farm yard manure application supported the findings, as numbers of trainings participated and number of extension contacts kept by the household head were positively and significantly affected to the adoption at 5% level of significance; while the other variables included in the model were insignificant. These findings were in line with the expectations and gave evidence to the importance of trainings and extension contacts with regards to technology adoption. As an example; for compost production, farmers need more practical skills which they can gain through trainings and extension contacts. Similar results were found by Wubeneh and Sanders (2006), and Nkamleu (1999). They indicated that, extension contacts had improved farmers' technology understanding and were significantly related to their adoption of nutrient management technologies. So the above results gave evidence to that expression.

It showed a negative relationship with land extent cultivated. A possible explanation is; due to difficulties of finding larger amounts needed for application with increased land extent; application of rare organic fertilizers such as cow dung, poultry manure and compost has very limited adoption. Therefore it gave evidence that, farmers were willing to apply these kinds of organic fertilizers for small land extents and for their own fields; as it gave a negative relationship with two dummy variables of land ownership. Same as with paddy husk charcoal application; it showed a negative relationship with age. These results therefore support the hypothesis that, younger farmers were more interested in getting experience with these kinds of new fertilizer management technologies, especially with regards to compost preparation with farm yard manure. Although most of the coefficient estimates confirmed expectations; here education showed a negative relationship with probability of the adoption. This may be because; the households, who were engaged in paddy cultivation with animal husbandry, were comparatively with a lower level of education than that of the others especially in Lunama AgS division. Meantime, probability of farm yard manure adoption showed a negative relationship with AgS division. Because of the surveyed households in Lunama division were cultivating significantly lower land extent with relatively higher landownership; and also having more labor availability per unit area of land, they were enabled to adopt this type of labor intensive technology. Labor availability per unit area of cultivated land in Ambalantota and Lunama divisions were 0.8 and 1.5 labors/acre respectively, and it gave evidence for the above explanations. As expected, membership of the household head in a farmer organization showed a higher positive coefficient (38.20) in the model meaning that; member household heads in a farm organization had higher adoption probabilities of farm yard manure application than non members. The coefficient of household income from other sources showed a positive relationship, which implied that it widens the possibility of adopting the application of farm yard manure by mitigating the shortage of capital input. Positive perceptions of the household head and also method of harvesting showed positive impacts on probability of the adoption of farm yard manure application.

According to the results of logit model; the cumulative distribution function for the adoption of farm yard manure application is as follows,

$$F(Z) = \frac{e^Z}{1 + e^Z}$$

$$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

Z = -39.36 + (-0.11* LAND) + (-0.83*LD_OWN1) + (-2.43* LD_OWN2) + (-0.07* AGE) + (-0.04 *EDU) + (38.2* MEMSP) + (0.35* TRAIN) + (0.42* LABOR) + (0.67* INCOME) + (0.19* EXTEN) + (0.03* MTD_H) + (0.32* PERCP) + (-0.55* AGS_D)

5.3.2 Marginal effects of independent variables on farm yard manure adoption

Marginal effects of explanatory variables for the above model were analyzed to find their effects on the adoption of farm yard manure application, and are presented in Table 5.8.

It widely believes that institutional support is an important factor that enhances the technology adoption. As expected, trainings attended and numbers of extension contacts kept by the household head were the important driving factors that affected farm yard manure adoption. Results of marginal effects showed that, with 1% increase of number of trainings attended by the household head, it tends to increase the probability of the adoption by 0.2%; and with 1% increase of number of extension contacts; tends to increase the probability of the adoption of farm yard manure by 0.1%. Results of past studies have proved this intervention of extension services on technology adoption (Ransom *et al.*, 2003). These results therefore, suggested the importance of increased institutional support in terms of trainings and extension contacts to promote the diffusion of knowledge regarding farm yard manure application in paddy cultivation. It may help the households to apply this technology as innovators and early adopters. The correct prediction for the non adoption is at 87.4% and it is at 5% for the adoption of the farm yard manure application. Therefore the percentage of correct predictions was good at 92.4% (Table 5.9).

Table 5.8: Marginal effects of independent variables on farm yard manure adoption

Variable	Marginal effect	Variable	Marginal effect
Constant	-0.18	TRAIN	0.0016**
LAND	-0.0005	LABOR	0.0019
LD_OWN1	-0.0035	INCOME	0.0000
LD_OWN2	-0.0051	EXTEN	0.0009**
AGE	-0.0003	MTD_H	0.0001
EDU	-0.0002	PERCP	0.0013
MEMSP	0.0579	AGS_D	-0.00

Note: ** indicate the level of significance at 5%

Table 5.9: Actual and predicted outcomes of the logit model on farm yard manure adoption

Actual value	Predicted value		Total actual
	0	1	
0	104 (87.4%)	2 (1.7%)	106 (89.1%)
1	7 (5.9%)	6 (5%)	13 (10.9%)
Total	111 (93.3%)	8 (6.70%)	119 (100.0%)

5.4 The adoption of green manure application

5.4.1 Factors affecting the adoption of green manure application

The decision to adopt green manure application was hoped to be a function of factors such as socio economic and institutional. The dependent variable took the value of 1 if the household was applying green manure with chemical fertilizers and 0 otherwise. Variables that were hypothesized to affect the adoption of green manure application included characteristics of the household head such as age, level of education, membership in farmer organization, number of trainings participated, number of extension contacts and perception on INM. It also included some characteristics of the household such as land ownership, total cultivated land extent, labor availability and income from other sources and also method of harvesting, and AgS division.

Land extent, method of harvesting and AgS division were hypothesized to affect either positively or negatively, while types of land ownership and age were hypothesized to affect negatively to the adoption probabilities. Meanwhile, other variables in the model were hypothesized to have positive impact on the adoption of green manure application.

An empirical specification was employed to investigate the relationship between the above factors and the adoption of green manure. (Table 5.10)

Table 5.10: Factors affecting the adoption of green manure application

Variable	Co-efficient	Standard Error	t-ratio	Sig
Constant	-69.69	$0.33*10^{07}$	0.00	1.00
LAND	0.15	0.23	0.67	0.50
LD_OWN1	-0.94	1.21	-0.77	0.44
LD_OWN2	3.33	1.83	1.82	0.07*
AGE	0.05	0.05	0.99	0.32
EDU	0.85	0.37	2.33	0.02**
MEMSP	26.86	$0.28*10^{07}$	0.00	1.00
TRAIN	0.20	0.21	0.95	0.34
LABOR	-0.15	0.33	-0.45	0.65
INCOME	-0.00	0.00	-2.31	0.02**
EXTEN	0.14	0.11	1.23	0.22
MTD_H	-0.18	1.32	-0.14	0.89
PERCP	29.57	$0.17*10^{07}$	0.00	1.00
AGS_D	-0.16	1.32	-0.12	0.90

Note: McFadden Pseudo $R^2$0.52 Chi squared 44.49 (df =13)

Log likelihood function -20.85 Restricted log likelihood -43.1

Prob [ChiSqd > value] = 0.00 LR statistics (13df) 44.49

Probability (LR stat) 0.00 Sample 119,

*, ** indicate significance at 10% and 5% level respectively

The R^2 value with 0.52 of the above model for probability of the adoption of green manure application suggested that, the estimated model was fairy good with 52% of explanatory power.

Education level of the household head was positively and significantly correlated to the adoption of green manure application. This result corroborates with the findings of Kassie *et al*., (2009), Sanni and Doppler (2007), Chinau and Tsujii (2004) and Bacha *et al*., (2001); that the level of education of the household head has a positive and significant influence on fertilizer adoption. Although non significant, LD_OWN1 showed a negative impact on the adoption and it revealed that the households who were engaged in paddy cultivation as tenants or leased, lowered the probability of the adoption of green manure application. But it showed a positive and significant impact of LD_OWN2 on its adoption. So it gave evidence that households who were cultivating leased lands at the same time with their own land had higher probabilities to apply green manure. Another important and noteworthy result was the total cultivated land extent by the household which was positively influenced on the adoption. But a converse result was found by Nekesa *et al*., (2007). This can be explained by the household planting behavior of green manure crops in study area. As they normally grow green manure crops like *Glyricidia sepium* as a border crop; the possibility of having required amount increases for the application with increased land extent; and it may enhance the adoption. This may be the reason for the impact of LD_OWN2 on technology adoption with increased land extent. But surprisingly, here the household income from other sources showed a significant and negative impact on the adoption. This was contrary to the findings of Zhou *et al*., (2008). The higher income households among surveyed households were represented by the combine harvester owners in both divisions. With higher income, these households may ignore the advantages of green manure application; and also planting behavior of these border crops may decrease their adoption probabilities as it disturbs mechanization in paddy harvesting.

As expected, membership of the household head in a farmer organization had positive influence on the adoption of green manure in paddy cultivation with the coefficient of 26.86. But household labor availability showed a negative impact on the adoption. This implied less importance of household labor force on green manure application; as they were highly depending on hired labor for it. Mechanical harvesting also negatively influenced on green manure application; because of limited border tree plantation with mechanization. This may be the main reason for the negative impact of AgS division on technology adoption; because significantly lower mechanization in paddy harvesting at Lunama AgS division may lead to increase green manure adoption. Age of the household head was another variable that positively associated with green manure adoption. This is an indication of the popularity of this technology among elder household heads in study area. Access to extension, measured by number of contacts kept by the household head with extension personnel within a season, positively related to the likelihood of green manure adoption. Number of trainings also showed a positive correlation with the adoption. This was in line with the results of Nguyen, (2001). Although non significant; positive perceptions of the household head on INM, showed a higher positive effect (29.57) on the adoption probability of green manure application.

5.4.2 Marginal effects of independent variables on green manure adoption

Even though good results were not able to achieve with related to the marginal effects of independent variables on green manure adoption; results revealed that probability of the adoption was higher among the households who cultivate their own land at the same time with leased lands, through increased land extent cultivated. The probability of the adoption of green manure application may increase by 0.013% with 1% increase of the number of households who cultivate leased land with their own field. It also predicted that one year increase of formal education of the household head it may lead to increase the adoption probability by 0. 001. It means that this adoption practice can be easily spread among the educated farmers in study area. Table 5.12 reveals that the correct prediction of this logit model is 94.1% with correct predictions for the non adoption at 87.4% and for the adoption at 6.7%.

Table 5.11: Marginal effects of independent variables on green manure adoption

Variable	Marginal effect	Variable	Marginal effect
Constant	-0.0004	TRAIN	0.0000
LAND	0.0000	LABOR	0.0000
LD_OWN1	-0.00001	INCOME	0.0000**
LD_OWN2	0.00013*	EXTEN	0.0000
AGE	0.0000	MTD_H	0.0000
EDU	0.00001**	PERCP	0.00034
MEMSP	0.00004	AGS_D	0.00000

Note: ** indicate the level of significance at 5%

Table 5.12: Actual and predicted outcomes of the logit model on green manure adoption

Actual value	Predicted value		Total actual
	0	1	
0	104 (87.4%)	1 (0.8%)	105 (88.2%)
1	6 (5.0%)	8 (6.7%)	13 (10.9%)
Total	110 (92.4%)	9 (7.6%)	119 (100.0%)

5.5 Prediction of the adoption of integrated nutrient management in study area

Table 5.13 shows the significant variables that can be used to predict four different INM adoption practices in study area. Accordingly, the highly affected factor to the adoption of INM practices was positive perception of the household head on rice straw adoption. Mechanical harvesting also showed a great influence on rice straw adoption. But if farmers have positive perceptions with regards to INM adoption, they may easily adopt straw application even with manual harvesting. Therefore to increase INM adoption through rice straw incorporation; it should facilitate paddy harvesting through combine harvesters, at the same time with taking measures to improve farmers' attitudes. Increased awareness on the advantages which they can achieve following straw application in rice fields will stimulate their perceptions to easily adopt this practice. Taking immediate measures to improve paddy farmers' skills with regards to paddy husk charcoal preparation and making compost using farm yard manure may lead to increase those practices. Therefore with the aim of increasing INM adoption through paddy husk charcoal and farm yard manure application; it is worth giving the priority to increase number of trainings with regards to the above practices at relevant institutions in study area. Enhanced extension services may also have a good contribution, especially to increase farm yard manure adoption. As household land ownership showed negative and positive impacts on paddy husk charcoal and green manure adoption; it showed a complex impact on INM adoption. But these results emphasize that paddy husk charcoal application can widely be distributed in study area, as the owner households constitute the majority in both AgS divisions; if they were trained well enough to apply this practice in their fields. Moreover, green manure application should be stimulated among well educated farmers especially among the households who cultivate their land with leased lands for better results. But according to these results, households with less income from other sources may easily be adopted in green manure application.

Table 5.13: Factors affecting the prediction of INM adoption

Variable	Rice straw adoption	Paddy husk charcoal adoption	Farm yard manure adoption	Green manure adoption
MTD_H	*			
PERCP	***			
LD_OWN2		* (-)		*
TRAIN		**	**	
EXTEN			**	
EDU				**
INCOME				** (-)

Note: *, **, *** indicate the level of significance at 10%, 5% and 1% respectively

(-): affected negatively

5.6 Summary of the chapter

There was a heterogeneity regarding factors influencing on different types of INM adoption. Farmers' positive perception and mechanical harvesting could be noticed as good predictors to improve rice straw adoption. Increased number of trainings with regards to paddy husk charcoal application; could be considered as a good predictor to enhance its adoption; and more adopters can be found in less commercialized paddy production systems. Increased number of trainings and extension contacts were good predictors to improve farm yard manure adoption. It could be predicted that farmers' good educational background and increased number of households who cultivate their own land with leased land, may increase the probability of green manure adoption; but with less household income.