THE DETERMINANTS OF THE ADOPTION OF FARM TECHNOLOGY BY RESETTLED FARMERS IN CHINYIKA, ZIMBABWE*

TENKIR BONGER

Ethiopian Development Research Institute

Abstract

Based on a sample survey of re(settled) households differentiated by whether any member was trained or not and their proximity to the Training Centre, employing Logistic Regression, Chi-Square Test, and Descriptive Statistics, this study examined the relationship between resources and household characteristics, on the one hand, and the probability of being trained or not, on the other. This was followed by an analysis of the log odds of a farm household adopting improved farming methods in relation to its status with respect to training, distance from the Training Centre and other social characteristics.

Unlike with resources owned, there is a more systematic relationship between taking the offer of training with non-resource household characteristics – education, sex, age and the prior residence and occupation of re(settlers). Paradoxically, the probability of a more educated household head joining the course is much smaller than the less educated.

Among the hypothesised household characteristics leading to the adoption of improved farming practices, whether the farmer was trained or not is the most important. This is followed by the educational level of female run households [as actual or de facto heads in the case of migrant husbands].

The results of the logistics regression clearly established a strong and statistically significant relationship between the probability of adoption on the one hand, training and, to some extent, urban origins and prior farming occupations, on the other. Those who own more cattle and oxen are also more likely to train and adopt innovations.

INTRODUCTION

The generation, dissemination and diffusion of adaptive agricultural technology holds the key to tackling rural poverty and making agriculture

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the bedrock of the development process through its role as a home market, mobilisation of surplus, and holding of agricultural labour before its enhanced demand in the non-agricultural sector [Ashby, 1990; Feder, 1985; Jha *et al*, 1991; Lipton:, 1989; Rogers, 1983; Thirtle *et al*, 1987]. The constraints to and the opportunities for adoption and subsequent increased productivity of labour, land and capital in the context of African and country specific scenarios have been debated by economic researchers and agronomists [Rogers, 1883; Beyene *et al*, 1991; Feder, 1985; Ghana Development Project; Jha *et al*, 1991; Lipton, 1989].

In either case, one of the pre-requisites of success in this realm is need-tailored training of small holders in improved farming practices adapted to their farming systems. Whereas there are a number of reports on the training curricula and process in Zimbabwe [Guveya, 1995; Cusworth, 1988; Kinsey, 1987; Government of Zimbabwe, 1992; 1991; 1981], there is a dearth of literature on the socio-economic characteristics of adopters and the impact of adoption on output and welfare.

The focus of this article, the Adlamont Farming System and Demonstration Centre [AFSDU] in Chinyika Resettlement, Makoni North District, Manicaland province, was set up as one of the major training and extension centres of the resettlement projects launched in the immediate post-independence period. It has been serving in that capacity since 1985.

The study attempted to identify the social profile of those who were beneficiaries of the free training offered and whether and to what extent training and the other social characteristics of the farm households have been determinants for the adoption of improved farming methods. The article is structured into four sections. Following this Introduction, Section 2 is a brief report on data collection, methodology, the statistical model used, and an overview of the training offered.

This is followed by an elucidation of the characteristics of those who took up the opportunity of training, the type and duration of the adopted improved practices. The final section reports on the results of the Logistic Regression, spelling out the determinants of adoption. Section four provides a synopsis and the policy implications of the findings of the study.

METHODOLOGY AND DATA COLLECTION

Data collection and methods

The impetus for the study originated from the collaborative research by the Faculty of Agriculture of the University of Zimbabwe funded by the Rockefeller Foundation. Until recently, the focus of the project was on animal and crop husbandry practices in the resettlement area. In 1995, a socio-economic dimension was added to examine the relationship between training at the AFSDU, adoption of improved practices, ensuing income levels and gauge the possible impacts on the welfare of the population. To this effect, fieldwork, which forms the basis of this artilce, was undertaken in the closing months of 1995.

The first step in the study involved discussions with staff of the AFSDU, various extension officers and farmers. With the assistance of extension officers, a sampling frame was drawn. In order to appraise the adoption process, the study households were grouped into "trained" and "untrained". Furthermore, to assess the influence of proximity of the Training Centre on the spread and depth innovation, adoption and resultant impact on productivity and levels of living, the villages were divided into those "near" and "far" from the Training Centre. Since all were located in the same ward, proximity was defined in terms of being the nearest and furthest village from the Centre.

Hence, to capture the impact of training and distance on the one hand and their joint effect on the other, the sampling frame consisted of "trained" and "untrained"; "near" and "far" referred to in succeeding test as "Training" and "Distance" respectively. In order to examine the joint effects of the above variables, households were also categorised as trained/near [TN], trained/far [TF], untrained/near [UN], and untrained/far [UF], which are jointly referred to as "Trandis" [combined effect of training and distance].

From each group, a proportionate sample of households was selected at random. 10% of the total comprising of 75 households formed the bases of the study. Owing to the large size of the village unit near the Training Centre, while the sample size of trained [38 households] and untrained [37 households] is almost equal, the sample size "near" the Centre [44 households] turned out to be significantly more than those located "far" [31].

Following extensive group discussion in the area, using the Participatory Rapid Appraisal [PRA] method as a base of data collection, a two-part questionnaire was designed. The first Section administered to all groups consisted of:

a. Household Particulars	b. Farm Assets	c. Incomes
d. Farm Expenditures	e. Adoption of Better Production Methods	
f. Stand of Living Indice	g. Needs Assessment.	

In addition to the above, those trained by the Centre were requested to provide information about:

h. The Selection Process	i. Details of Courses Taken
j. Application/Adoption	k. Evaluation and Recommendation

Data were coded and entered into the Statistical Package for Social Scientists (SPSS) computer package. From the initial data set, other variables such as consumer unit, labour unit, cattle unit, etc were generated via computations as per the requirements of model building and the further pursuance of the implications of preliminary findings. Others were summarised such as under suitable class intervals to make them amenable for test of independence in the application of Chi-square tests.[1]

THE STATISTICAL MODEL USED AND THE ALIGNMENT OF DEPENDENT AND INDEPENDENT VARIABLES

One of the main purposes of the study was to identify the social characteristics of those who took up training opportunities. If training is taken to be a dependent variable and a desirable outcome, the Logistic Regression model estimating the probability of training among different farmers with varying social characteristics was found to be a suitable statistical method. The usefulness of the technique is further enhanced by the prevalence of dichotomous characteristics not only of the dependent variables, trained/non-trained; near/far but also among the hypothesised independent variables such as sex, ex-residence and to some extent occupation of the farmers under study.

For the case of a single independent variable, say the sex of the spouse (F) and the adoption of fertiliser, the regression model can be written as:

Prob (F adoption) = eBo+B1X/1+eBo+B1X 1
Dividing by eBo+eB1X, it becomes 1/1+êBo+BX 2
Where:

Bo and B1 are coefficients estimated by from the data
X is the independent variable
e is the base of the natural logarithm, approximately 2.718.

For more than one independent variable, the model can be generalised as:

Prob(adoption) = ez/1+ez 3
or equivalently, by dividing eq 3 by its numerator:
Prob (adoption) = 1/1+e-z 4

Where z is the linear combination of all the adoption practices, which may be expressed as:

1. For more details of data collection and methods, see another article based on the same study. Bonger, T. "The Effects of Training on the Incomes and Welfare of Farmers in the Chinyika Resettlement Scheme" (Forthcoming).

Z = Bo+B1X1+B2X2+ . . . . +BnXn 5

Then the probability of non-adoption becomes:

Prob. (non adoption) = 1-prob (adoption) 6

Once equation 5 is estimated, the probability of adoption [in this case by a myriad of household characteristics], it is then applied to compute the probability of adoption by inserting the z values as per equation 4.

In general, when the estimated probability is:

a. <0.5, we predict that innovations will not be adopted
b. >0.5, we predict that innovations will be adopted
c. =0.5, we are not certain either way, may be flip a coin

Having estimated the coefficients, a test of significance for the null hypothesis that they are different from zero is given by the Wald Statistic.[2]

The contribution of individual variables, measured by the R statistic, the partial corr [ranging between +1 and -1] between the dependent var and each of the independent vars, is given by:

R=+ Wald Statistic – 2K/ -2LL (0). 7
Where:
K is degree of freedom
LL is the log likelihood of a base model that contains only the intercept.

A positive value indicates that as the variable increases in value so does the likelihood of adoption and vice versa. Small absolute values indicate that the variable has a small partial contribution to the model.

The logistic regression model can be re-written in terms of the odds of an event occurring which is defined as the ratio of the probability that a household will adopt the innovations to that they will not adopt. Hence, the estimation in equation 5 can be rewritten as:

log [(prob(adoption)/ prob (non-adoption)]
= Bo+B1X1+B2X2+ . . . . +BnXn 8

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2 This is for a large sample and the statistic has a Chi Square distribution. Where a variable has a single degree of freedom, the Wald statistic is the square of the ratio of the coefficient to the standard error. For categorical variables, the statistic has degrees of freedom equal to one less than the categorical variables.

Since it is easier to think of odds rather than log odds, the logistic equation can be written in terms of odds as:

Prob(adoption)/pro(non-adoption)
= eBo+B1X1+ . . . . +BnXn 9

The logistic coefficient is the change in the log odds associated with a one-unit change in the independent variable. The e raised to the power of B is the factor by which the odds change when the ith independent variable increases by one unit. If:

Bi is +ve, the factor will be 1, the odds are increased
Bi is –ve, the factor will be 1, the odds are decreased
Bo is 0, the factor equals 1, leaves the odds unchanged.[3]

In order to assess whether or not the model fits the data. classificatory table, the value of –2LL and/or goodness of fit statistics can be used. For details, see advanced SPSS (1995), "Logistic Regression Analysis", Chapter 1.

Like other statistical models, adequacy of the results of the logistic regression needs to be examined. The standardised residual, the studentised and Cook's distance are some of the main tests. All analyse the magnitude and behaviour of the residuals between the expected and actual values of the variables.

In view of the fact that most of the variables denote socio-economic characteristics, a 10% level of significance is used as the cut off point to accept or reject implied hypotheses.

A priori, the following 12 explanatory variables [including the double items under household heads and spouse], most of which are household social characteristics, were hypothesised to increase the probability of taking up training opportunities, followed by the adoption of a variety of innovations and improved farming methods.

Disseminated innovations

The Adlamont Training Centre began its activities in 1989. Up to June 1995, it offered 15 courses to a total of 213 participants with about 14 in each session. Although they are the majority farmers, at about 40% of the participants, women trailed men. The overwhelming number who

3 These respective parameters of the independent variables are given as Exp (B) in SPSS output.

Household Characteristics	Training and Adoption
1.1.1 Status of training: Trained or untrained	1.2.1 Fertiliser use
1.1.2 Distance from AFSDU: near and far	1.2.2 Fertiliser Application
1.1.3 Residence: HHH and spouse prior to resettlement rural or urban	1.2.3 Livestock breeding 1.2.4 Chemical use
1.1.4 Occupation: HHH and spouse prior to resettlement farming or other	1.2.5 Harvesting 1.2.6 Land Preparation
1.1.5 The education level: HHH and spouse	1.2.7 Threshing
1.1.6 The age of HHH and spouse	1.2.8 Sowing
1.1.7 Sex: HHH and Spouse	1.2.9 Forage Improvement
	1.2.10 Planting
	1.2.11 Bird Breeding
	1.2.12 Seed Selection

participated in the courses came to know about it from extension agents. While most volunteered for the courses, others were interviewed before their admission.

The most frequently mentioned course undertaken is livestock management including aspects of managing paddocks/velds, dehorning, castration, poultry, dosing, rabbitry, etc [33%] followed by arable farming such as crop production, feeding livestock, land preparation, plough setting, harnessing, planting, crop rotation, transplanting, soil sampling, spacing, ridge/contour making, shelling of maize, fertiliser application and treatment, spraying, harvesting, compost making, Master Farmer Training, vegetable growing, etc.[4] Few cases of accounting and leadership courses were also offered.

A variety of training methods were used of which demonstration of the above, visits and lectures were the most important. The participants specially applauded courses in livestock production, poultry, and demonstrations on winter ploughing, livestock and poultry production.

RESULTS

Training

In order to understand the factors differentiating those who attended the training courses from others who did not, a Chi-Square Test and Logistic Regression coefficient estimations were undertaken with respect to

4 They were asked to name the first, second and third most important subject/course. These were then given weights of 1.0, 0.5 and 0.33 respectively.

resources and household characteristics respectively. While positive in 13 out of 15 cases, the relationship between resources on the one hand and training on the other were significant only with respect to the ownership of cattle[5] [Table 3.1]. Although insignificant, there is a strong probability of those with more oxen joining training courses.

Since land was distributed equitably at the onset of the resettlement, the least probability explaining whether trained or not was size of holding. Families with more consumer demand and/or labour supply were no more or less probable to be among the trained or not. The nearer a household to the Training Centre, the more its resources but at insignificant level. Like with training, there is a positive and significant relationship between "trandis" and cattle unit. The statistical result is reported below [Table 3.1].

The most significant relationship is the least expected. As shown in the sign and the high level of significance, the probability of a more educated household head joining the course is much smaller than the less educated [Table 3.2]. While this may appear paradoxical, among the highly educated, more of their better farming practices are acquired through other formal and informal venues leaving training such as is offered at Adlamont to their less educated brethren. The more formally educated may look down upon not only sitting in the same course with the 'semi-literate', but even with the extension agent. Educational level of spouse is positively related but not significant [Table 3.2].

Unlike with resources owned a) shown under Table 3.1, there is a more systematic relationship between taking the offer of training with non-resource household characteristics – education, sex, age and residence and occupation prior to resettlement by household heads and their spouses. The result is shown in the following table.

The younger a household head, the more likely to enrol in training and at a statistically significant level. There is no relationship with the age of the spouse. While the report of the Training Centre gives more trained men, among the respondents, although at insignificant level, women are more likely to enrol for training than men. This is understandable given that they perform most agricultural tasks.

Perhaps the most interesting finding with immense policy significance in future resettlement programmes is *the relationship between the pre-settlement residence and occupation of household heads and training*. Their

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5 In terms of valuation, perhaps more than land since land was distributed at almost no cost while the livestock are the result of farmers' own toil before the resettlement and after.

Table 3.1
TRAINING, DISTANCE AND RESOURCE OWNERSHIP

	CtU[6]		OX		HA		CU[7]		LU[8]	
	Sig	**SC**	**Sig**	**SC**	**Sig**	**PC**	**Sig**	**SC**	**Sig**	**SC**
1. Training	.02*	0.30	.10	0.30	.54	0.06	.44	0.04	.77	-0.02
2. Distance	.55	0.15	.33	0.12	.51	0.14	.73	0.07	.37	0.00
3. Trandis	.08*	0.30	.17	0.29	.55	0.11	.71	-0.06	.63	0.01

SC = Spearman's Correlation; Sig = significance; CtU = Cattle Unit; OX = Oxen; HA = Holding in hectare; CU = Consumer Unit; LU = Labour Unit

Table 3.2
HOUSEHOLD CHARACTERISTICS AND TRAINING

	Coeff	**Sig**		**Coeff**	**Sig**
1. Ed of HH	-0.53	0.0006**	7. Distance	0.63	0.11
2. Ed-Spouse	0.12	0.34	8. Ex-occ HH	0.93	0.05*
3. Age of HH	-0.07	0.03**	9. Ex-occ Sp`se	0.50	0.31
4. Age – Spouse	0.01	0.98	10. Ex-res HH	-0.98	0.04*
5. Sex of HH	-0.61	0.21	11. Ex-res Sp'se	0.34	0.41
6. Sex – Spouse	-0.26	0.43			
Constant	6.20	0.0004**			

d. f 11 | Chi Sq sig 0.0004 | Predicted 75.7%

Ed = Education
Ex-occ = Previous Occupation
Ex-occ Sp'se = Previous Occupation of Spouse
HH = Household Head
Ex-res = Former Residence of Spouse
Ex-res Sp'se = Former Residence of Spouse

urban pre-settlement residence coupled with a rural background in farming/labouring very significantly increases the probability of taking part in training. While insignificant, a spouse's background of rural residence and occupation increase the probability of being trained in better farming methods [Table 3.2].

The course participants were requested to evaluate the course in terms of relevance, content, duration, frequency of offerings, and method. They were also invited to provide suggestions for improvements in such

6 Different ages and types standardised according to internationally accepted weighting (see Guveya, 1995).

7 To take into account the consumption demand, weighted as 0-1=0.3; 2-3=0.4; 4-6=0.5; 7-8=0.7; 9-12=0.8; 13-15=1.0; 16-19=1.2; and >20=1.0.

8 Weighted with age group of 0-4=0; 5-9=0.25; 10-14=0.5; 15-19=0.75; 20-50=1.0; 51-60=0.75; and >60=0.5 to stand as proxies for potential supply of labour. See reference 6 above.

areas as sequencing, selection of candidates and presentation/delivery of the course. Few ventured to criticise the course saying that it was already good. The only major *recommendation was that the medium of instruction be in the local language, Shona, instead of English as is the case now.*

Among the courses undertaken, the ratings as important subjects were crop production [17%], livestock production [15%], ploughing [12%], soil fertility [12%], castration and de-horning [10%], spacing [7%], dozing [5%], veld management, farm management and the application of chemicals at 2% each. More than two-thirds of the trainees reported to have passed their training to other fellow farmers. The demand came through discussion and most of it was undertaken at the ex-trainee's homestead.

Adoption: Types and duration

The most commonly mentioned areas of transfer of knowledge were poultry, crop management, castration, livestock management, and planting/spacing. Having established the profile of the trainees, the next sub-section analyses the types of adoption and the duration of their embodiment in the cognition of the farmers. About half of the total farmers have adopted, at least, one innovation on the average for eight years. As could be further discerned from the table, there is a wide variation in the duration of adoption, the number of farmers adopting different types of innovations and that between the late and early adopters as captured by the Q3/Q1 ratio.

Despite the existence of the Training Centre for about a decade, the minimum period of adoption of most practices goes down to as late as 1995, a season before the year of fieldwork. Land preparation, planting, and fertiliser application are the most widely adopted practices. This is in line with demonstrations reported in such areas as plough setting and harnessing, planting, tillage, soil conservation, rotations, soil sampling, winter ploughing, spacing, planting legumes, vegetable growing, ridging, and contour making, transplanting and spraying.

The next set of higher adoption rates are livestock breeding/ management, sowing and harvesting. Next to land, livestock are the most important resources. Improved livestock breeding and management methods such as dosing, castration, and de-horning figure among the most useful lessons and demonstrations from training. On the other hand, those practices which require cash working capital but expected to generate immediate return through increased land and labour productivity – chemicals, fertiliser, and selected seed use – are adopted by only about one-third of the households.

Although as many as 77% of the households reported awareness and training about the application of fertilisers, just less than half reported its

Table 3.3
BETTER FARMING PRACTICES ADOPTED AND THEIR DURATION

Type of Innovation	Max[9]	Min	Mean	SD	Number of years Q1	Q2	Q3	Q3/Q1	%*
1. Bird Breeding	13	1	6	4.2	5		10	5.0	32
2. Chem Sel/Appl	43	1	7	8.3	7		11	3.7	43
3. Fert Appl	43	1	7	6.9	3	6	11	3.7	77
4. Fert Use	43	1	9	9.6	3	6	11	3.7	36
5. Harvesting	55	1	12	11.7	3	9	13	4.3	52
6. Land Preparation	56	1	10	.4	3	9	12	4.0	80
7. Livestock Breeding	13	1	5	4.3	2	3	8	4.0	52
8. Planting	56	1	10	.1	7		12	12.0	80
9. Seed Selection	43	1	7	9.6	1	4	10	10.1	31
10. Sowing	56	2	11	.0	4	9	12	3.0	53
11. Storing	43	2	9	7.8	5	9	11	2.2	48
12. Threshing	43	2	8	9.7	3	5	9	3.0	31
Mean	**42**	**1**	**8**	**0.6**	**3**	**7**	**11**	**3.7**	**51**

* Of those who responded
Q1 = First Quartile
Q3 = Third Quartile on the basis of duration of adoption.
Q2 = Second Quartile
Appl = Application
Fert = Fertiliser
Sel = Selection

direct use. In an analysis of the correlation between adoptions, it was found out that those who adopt the latter and better livestock breeding methods are also engaged more than other farmers are in the applications of other innovations.

Rather than the training centre, extension is by far the largest source of the adopted innovation especially for those requiring technical expertise such as the application and use of fertilisers, seed selection, and chemicals. Model farmer training and the Adlmont Training Centre shared 10% each. It is instructive to note that most model farmer training is conducted at the Adlamont Training Centre, thus its share as a source of innovation is higher than 10%. So far, the impact of the printed and audio-visual media is virtually non-existent.

9 Although the resettlement has been in operation for about 10 years at the time of the study, the maximum periods of adoption stretching to over 50 years in some cases is due to resettlement of hitherto communal area farmers who had been familiar with some of the innovations under study. See the impact of this on the statistical analysis in the succeeding chapters where this is modelled as "Occupation" and "Residence" before arrival at the resettlement.

Table 3.4
SOURCES OF THE ADOPTED PRACTICES

	SOURCES OF INNOVATIONS[10]								
Innovation	**OA**	**Ext**	**OF**	**ADC**	**MFT**	**Radio**	**Other**	**Tot**	**# Responses**
1. Bird Breeding	4	58	—	15	10	—	13	100	35
2. Chemical/Use	—	62	—	10	13	—	15	100	39
3. Forage	—	61	—	13	11	—	15	100	35
4. Fertiliser Use	—	68	—	14	7	—	11	100	37
5. Fertiliser Application	—	71	6	7	5	—	11	100	75
6. Harvesting	16	49	6	11	8	—	10	100	53
7. Land Preparation	9	63	7	9	—	—	12	99	76
8. Livestock Breeding	—	63	9	20	9	—	—	101	47
9. Planting	10	68	—	8	6	3	5	100	84
10. Seed Selection	—	65	11	—	14	—	9	99	31
11. Sowing	14	51	7	12		—	5	101	67
12. Storing	—	45	17	15		—	8	100	44
13. Threshing	11	41	23	—	18	—	7	100	29
Mean	**5**	**59**	**7**	**10**	**10**	*****	**9**	**100**	**50**

OA = Original Area
MFT = Model Farmer Training
* = Less than .5%.
Ext = Extension here
OF = Other Farmers
Other = Self, father etc.

The Profile of Adopters and Impacts of Training and Proximity to the AFSDU: Results of the Logistic Regression Model

Training

Among the hypothesised household characteristics leading to adoption, whether the farmer was trained is the most important one. The change in the log odd associated with training increases by a factor of more than one in 75% of the cases. With trained set at 0 and non-trained at 1 [recorded by the SPSS programme unto –1 and 1 respectively], all the coefficients are positive [implying increase in the probability of adoption with training] and significant at 0.05 level in all cases except with respect to sowing. In the latter case, the significant of the coefficient is 0.11. In seven cases out of 12, they are significant even at 5% level.

10 Many of the innovations were acquired from a variety of combinations of the sources given below. To ease analysis, they were broken down into respective fractions and later aggregated under each.

Distance from the AFTDU

Except for those who adopted improved bird breeding methods, when near is set as 1 and far as 0, the positive coefficients for distance from the Demonstration Centre, demonstrate the probability of adoption becoming higher as one lives nearer to the Centre. Only in 4 cases comprising fertiliser use, land preparation, threshing and sowing, the coefficients are significant. It appears that the decisive impact of training on the adoption of all the new technologies and farming practices is partly complemented by the location of the farmers nearer to the Demonstration Centre.

Education

The second most important variable increasing the probability of adoption is the education of spouses – these are females running the households [actual and *de facto* household heads] with migrant husbands. The impact is significant at 10% and less levels with respect to fertiliser use, livestock breeding, application of chemicals, harvesting, threshing, planting, and bird breeding. While more education increases the probability of adoption of all the improved methods, none is significant even at the 10% level. Given the high post literacy rate of males who are reported to head the households even in their absence, it is important to note the higher marginal return from more and relevant education to women. Including findings in the succeeding sections, it must be borne in mind that part of the explanation of more adoption by women is because there are more women farmers than men.

Occupation Prior to Resettlement

In all cases and among both spouses, those who come from non-farming but with urban origins are more likely to adopt improved farming methods. As in education, this is more relevant among spouses than household heads. Among the former, the relationship is significant at 10% level for the adoption of chemicals, better harvesting methods, land preparation, threshing, sowing, and forage management. Only fertiliser application is significant with respect to household heads. This is probably because of the higher awareness, knowledge of techniques of applications, and the ability to finance such ventures by senior male members of the households.

Place of Residence Prior to Resettlement

This is of course related to occupation. Those who had rural origins were mostly communal area farmers while those who came from the urban areas held non-farming jobs. As under occupation prior to resettlement, the probability of adoption of innovation by those coming from the urban areas is higher but at significant levels only among the spouses. Thus, spouses with urban backgrounds are more likely to apply chemical, fertiliser, better harvesting, threshing, seed selection, and land preparation methods at 10% or less levels of significance.

Table 3.5

ADOPTION OF IMPROVED FARMING PRACTICES AND HOUSEHOLD SOCIAL CHARACTERISTICS[11]

	Applications											
HH Character	**Fert B**	**Use Sig**	**Fert B**	**Applic Sig**	**Liv B**	**Breeding Sig**	**Chemicals B**	**Sig**	**Harvesting B**	**Sig**	**Land B**	**Prep Sig**
1. Training	1.4	.00**	1.1	0.02**	0.7	0.07*	1.1	0.02**	1.3	.00**	1.0	0.10
2. Distance	0.7	.07*	0.5	0.28	0.0	0.99	0.2	0.68	0.6	.13	1.2	0.06*
3. Age HH	-0.0	.98	-0.0	0.46	0.0	0.44	0.0	0.40	-0.0	.44	0.0	0.80
4. Ex occu HH	0.1	.75	-0.9	0.07*	0.5	0.26	0.5	0.36	0.4	.47	0.5	0.37
5. Ex res HH	-0.5	.26	-0.2	0.60	0.2	0.53	-1.2	0.02*	-0.4	.36	0.1	0.81
6. Educ HH	-0.1	.61	-0.1	0.43	0.1	0.46	-0.1	0.70	-0.0	.57	0.2	0.38
7. Sex HH	-0.3	.61	0.5	0.32	-0.4	0.38	0.4	0.51	0.8	.14	0.3	0.57
8. Age Spouse	-0.0	.87	0.0	0.40	0.0	0.45	-0.0	0.49	0.0	.85	0.0	0.96
9. Ex occu Sp	-.0.7	.17	-0.3	0.30	-0.5	0.27	-1.5	0.02*	-0.9	.07*	-1.0	0.08*
10. Ex res Sp	-0.1	.84	-1.0	0.04**	-0.3	0.46	-0.8	0.10*	-0.8	.06*	-1.7	0.00**
11. Educ Sp	0.3	.04**	-0.0	0.85	0.2	0.07*	0.3	0.10*	0.3	.06*	-0.2	0.33
12. Sex Spouse	-0.1	.92	0.5	0.32	-0.8	0.26	-0.5	0.20	-0.3	.40	-0.7	0.26
Constant	-1.6	.38	2.4	0.25	-2.3	0.17	-3.2	0.14	-0.4	.84	1.8	0.46
Chi Square Statistic Sig		0.01		0.01		0.03		0.0001		0.0001		0.017
Prediction		75.7%		84.3%		70.0%		81.4%		82.7%		92.9%

11 Irrespective of the method of entry of variables in the computer generated model, among others, the output of the SPSS LR gives the classification table for the predicated and observed variables, the calculated Chi Square value and its significance, the coefficient (S) of the regression, their S. E.,

Table 3.5 (cont)

	Applications											
	Treshing		Sowing		Forage		Planting		Bird Breeding		Seed	Selec
HH Character	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
1. Training	1.2	0.01**	0.6	0.11	0.9	.4*	0.8	0.08*	1.0	0.02*	0.7	0.05
2. Distance	1.2	0.01*	1.1	0.01*	0.4	.31	0.6	0.22	-0.5	0.89	.3	0.34
3. Age HH	-0.0	0.81	0.0	0.29	0.0	.26	0.0	0.37	0.0	0.82	0.0	0.65
4. Ex occu HH	0.7	0.22	0.0	0.99	0.2	.76	-0.2	0.67	-0.4	0.34	0.4	0.38
5. Ex res HH	0.1	0.98	-0.6	0.13	-0.2	.71	-0.1	0.81	-0.6	0.17	0.5	0.23
6. Educ HH	-0.2	0.21	0.1	0.37	0.1	.88	0.2	0.30	-0.2	0.25	-0.0	0.78
7. Sex HH	0.0	0.96	-0.9	0.08*	0.7	.19	-0.2	0.73	0.2	0.67	-0.1	0.68
8. Age Spouse	-0.1	0.65	0.0	0.75	-0.0	.24	0.0	0.42	-0.0	0.18	-0.0	0.96
9. Ex occu Sp	-1.5	0.02*	-1.1	0.02*	-1.1	.03**	-0.2	0.72	-0.2	0.97	-0.5	0.29
10. Ex res Sp	-1.6	0.00**	-0.0	0.91	-0.1	.88	-0.2	0.72	0.1	0.90	-0.9	0.03*
11. Educ Sp	0.3	0.08*	0.0	0.84	0.1	.50	-0.2	0.09*	0.3	0.02**	0.0	0.84
12. Sex Spouse	0.1	0.70	0.1	0.74	-0.3	.40	0.2	0.57	0.3	0.39	-0.1	0.68
Constant	-1.1	0.62	-1.8	0.32	-2.5	.17	-0.4	0.87	-2.1	0.28	-1.4	0.40
Chi Square Statistic												
Sig		0.004		0.0135		0.0430		0.0742		0.0455		0.0135
Prediction		81.4%		81.4%		80.0%		81.4.9%		77.1%		81.4%

Fert = Fertiliser SP = *Spouse;* Applic = Application: Selec = *Selection;* Liv = Livestock; *Prep* = preparation

the Wald Statistic about the hypothesis that the coefficients are zero, the degrees of freedom, the significance level of the coefficients, the R statistic of the partial contribution of the variables in the model and the exponents of the coefficients. In view of the large number of adopted innovations and the 12 household characteristics as independent variables, in the following table, only the value of the coefficients and their significant levels are given together with the significance and the overall predictive percentage of the classification table of the Chi Square statistic. The tables are followed by interpretations about the sign and the statistical significance of each of the coefficients of the independent variables.

Age and Sex of Household Heads and Spouses

Among both men and female household heads and spouses, there is no consistent and significant relationship between age and levels of adoption. Perhaps reflecting the findings under prior occupation and residence, spouses [who are mostly women] rather than household heads are more likely to adopt farming innovations but it is not statistically significant.

The set of adoption of the above innovations were regressed on resources by households with the following results under Table 3.6. In 35 cases out of 48, the coefficients have the expected signs, i.e. an increase in the assets also increases the probability of adoption. However, in general, the relationship between the probability of adoption and household assets expressed by cropped area, cattle, oxen and labour are very low and significant at 10% level in only four out of the possible 48 cases. These are use of chemicals and improved methods of threshing with cropped area, the adoption of improved horticulture seed with the ownership of oxen and threshing with labour unit. Access to resources could have been the results of and proxies of capability for adoption.

Table 3.6

ADOPTION OF IMPROVED FARM PRACTICES AND HOUSEHOLD RESOURCES

a. Coefficients and Levels of Significance

	CrHa		**CtU**		**Oxen**		**LU**	
Applications	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**	**B**	**Sig**
1. Fertiliser Use	0.4	.21	0.0	.94	0.3	.22	0.6	.25
2. Fertiliser Application	0.4	.26	0.1	.64	-0.0	.91	0.9	.16
3. Livestock Breeding	0.4	.20	-0.0	.60	0.4	.14	0.4	.48
4. Chemicals	0.5	.10*	-0.0	.95	0.2	.31	0.2	.11
5. Harvesting	0.3	.37	-0.1	.22	-0.3	.28	0.8	.12
6. Land Preparation	-0.0	.93	0.1	.58	-0.1	.86	0.6	.39
7. Threshing	0.64	.08*	0.1	.47	0.1	.85	1.2.	02*
8. Sowing	0.2	.43	-0.1	.27	-0.1	.55	0.6	.24
9. Seed/Horticulture	-0.0	.99	-0.1	.33	0.6	.05*	0.9	.17
10. Planting	0.0	.93	0.1	.69	0.0	-92	0.6	.36
11. Bird Breeding	0.4	.25	-0.1	.41	0.3	.17	0.9	.13
12. Seed/Crop	-0.4	.31	0.1	.20	0.1	.81	1.0	.13

CrHa = Hectarage under crops

b. Logistic Regression Statistic

Applications	**OPP**	**CSR**	**Df**	**CSSL**
1. Fertiliser Use	73	10.7	4	0.0571
2. Fertiliser Application	79	5.6	4	0.3454
3. Livestock Breeding	69	7.4	4	0.1935
4. Chemicals	67	10.6	4	0.5080
5. Harvesting	63	7.2	4	0.2031
6. Land Preparation	83	3.1	4	0.6909
7. Threshing	65	7.7	4	0.1727
8. Sowing	61	3.6	4	0.6013
9. Seed/Horticulture	80	7.8	4	0.1669
10. Planting	80	2.0	4	0.8484
11. Bird Breeding	73	8.0	4	0.1524
12. Seed/Crop	72	14.4	4	0.0130

OPP = Overall Prediction % CRS = Chi-Square Statistic
DF = Degree of freedom CSSL = Chi- Square Significance level

SUMMARY AND POLICY IMPLICATIONS

The results of the logistics regression clearly established the strong relationship between the probability of adoption on the one hand, training and to some extent urban origins and prior farming occupations on the other. Those who own more cattle and oxen were also more likely to train and adopt innovations.

While positive in 13 out of 15 cases, *the relationship between the ownership of resources and training were significant only with respect to the ownership of cattle*. Since land was distributed equitably at the onset of the resettlement, *the least probability among resources explaining whether trained or not was size of holding*. Families with more consumer demand and/or labour supply were no more or less probable to be among the trained or not.

Unlike with resources owned, *there is a more systematic relationship between taking the offer of training with non-resource household characteristics – education, sex, age and residence and occupation prior to resettlement by household heads and their spouses*. The probability of a more educated household head joining the course is much smaller than the less educated. The younger a household head, the more likely to enrol in training and at a statistically significant level. There is no relationship between training and the age of the spouse.

The most interesting finding with immense policy significance in future resettlement programmes is the relationship between the pre-settlement residence and occupation of household heads and to a lesser extent of their spouses and training. Their urban pre-settlement residence coupled with a rural background in farming/labouring very significantly increases the probability of taking part in training. While not statistically significant, a spouse's background of rural residence and occupation increase the probability of being trained in better farming methods. A major recommendation in the organisation of the training course was that the medium of instruction be in the local language, Shona, instead of English as is the case now.

About half of the total farmers have adopted, at least, one improved farming method on the average for eight years. On the other hand, those practices that require cash working capital but expected to generate immediate return through increased land and labour productivity – chemical, fertiliser and selected seed use – are adopted by only about one-third of the households. Although as many as 77% of the households reported awareness and training about the application of fertilisers, just less than half reported its direct use.

In an analysis of the correlation between adoptions, it was found out that those who adopt the above three innovations and better livestock breeding methods also engaged more than other farmers in the applications of the other eight innovations. Hence, future policies and activities should address this high level of differentiation in adoption and the ensuing benefits.

Among the hypothesised household characteristics leading to adoption, whether the farmer was trained or not is the most important one. The change in the log odd associated with training increases by a factor of more than one in 75% of the cases. All the coefficients of training and the adoption of improved methods of farming are positive [implying increase in the probability of adoption with training] and significant at 10% level [at 5% level in seven out of 12 cases] in all cases except with respect to sowing. Even in the latter case, at 0.11, the significance level is just out of the cut-off point. The decisive impact of training on the adoption of all the new technologies and farming practices is partly complemented by the location of the farmers nearer to the Demonstration Centre.

The second most important variable increasing the probability of adoption is the education of spouses – these are females running the households [actual and de facto household heads] with migrant husbands. In most cases, the relationships are significant at 10%. While more education of household heads increases the probability of adoption of all the improved methods, none is significant even at the 10% level. Given the high post literacy rate of education among males who are reported to head the households even in their physical absence, there appears to be a higher marginal return from more and relevant education to women.

In all cases and among both spouses, those who come from non-farming but with urban origins are more likely to adopt improved farming methods. As in education, this is more relevant amc g spouses than household heads. As under occupation prior to resettlement, the probability of adoption of innovation by those coming from the urban areas is higher but at significant levels only among the spouses. Thus, spouses with urban backgrounds are more likely to apply chemicals, fertiliser, better harvesting, threshing, seed selection, and land preparation methods at 10% or less levels of significance. Based on the foregoing, including urban household heads but more importantly, together with their spouses interested in farming, the findings could be used as one of the criteria in the selection of future settlers. The relationship between the probability of adoption and household assets expressed by cropped area, cattle, oxen, and labour are very low and significant at 10% level in only 4 out of the possible 48 cases. These are use of chemicals and improved methods of threshing with cropped area, the adoption of improved horticulture seed with the ownership of oxen and threshing with labour unit.

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Appendix Table 1
AGE AND SEX DISTRIBUTION OF CHINYIKA HOUSEHOLDS

				Cum %		
Age Group	**F**	**M**	**Tot**	**F**	**M**	**Tot**
0-4	3.1	2.8	5.9			
5-9	4.2	5.0	9.2	7.3	7.8	15.1
10-14	8.7	10.1	18.8	16.0	17.9	33.9
15-19	7.0	7.6	14.6	23.0	25.5	48.5
20-24	4.5	7.3	11.8	27.5	32.8	60.3
25-29	1.1	3.1	4.2	28.6	35.9	64.5
30-34	3.4	0.8	4.2	32.0	36.7	68.7
35-39	2.0	1.7	3.7	34.0	38.4	72.4
40-44	2.0	0.8	2.8	36.0	39.2	75.2
45-49	3.4	1.4	4.8	39.4	40.6	80.0
50-54	3.4	1.7	5.1	42.8	42.3	85.1
55-59	2.5	2.2	4.7	45.3	44.5	89.8
59	7.8	2.5	11.3	53.1	47.0	101.1
Total	**53.1**	**47.0**	**100.1**			

Appendix Table 2
TRAINING CONDUCTED AUGUST 1989 – JUNE 1995

Date	Subject	Fem	Males	Total
1. June 26-30, 1995	Poultry	2	4	6
2. June 5-9, 1995	Poultry	4	10	14
3. April 3-5, 1995	Cattle Management	13	16	29
4. 1993-1995	Master Farmer Training	7	6	13
5. 1993-1994	Adv. Master Farmer Training	2	2	4
6. 1992-1994	Master Farmer Training	3	9	12
7. Sept 1-5, 1993	Poultry Production	11	9	20
8. Sept 23, 1993	Vegetable Production	13	6	19
9. Sept 16-20, 1991	Crops & Farm Management	6	10	16
10. Feb 10, 1992	Animal Power	2	7	9
11. June 17-21, 1991	Leadership	3	7	10
12. Mar 26-27, 1991	Cattle Management	6	11	17
13. Oct 3-5, 1990	Farm Management	4	10	14
14. Oct 23-27, 1989	Animal Power	6	12	18
15. Aug 14-18, 1989	Vegetable Production	6	6	12
Total		**88**	**125**	**213**