Journal of Development and Agricultural Economics Vol. 4(4), pp. 109-118, 26 February, 2012
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE12.002
ISSN 2006- 9774 ©2012 Academic Journals

*Full Length Research Paper*

# Factors affecting yields of field crops and land utilisation amongst land reform beneficiaries of Mashonaland Central Province in Zimbabwe

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Accepted 9 February, 2012

**The objectives of the study were to determine the level that resettled farmers in Mashonaland Central Province of Zimbabwe utilise their land in the production of field crops as well as to determine their mean yields per hectare. Factors that affect yield and land utilisation were also determined. Data was collected from 245 households using a questionnaire as the main instrument. The majority of the households in the resettled areas, A1 (91%), A2 (87%) and the old resettlement areas (70%) were male-headed and had at least primary education. A2 farms have the lowest mean yield per hectare of US$714.80 which significantly differed from A1 (US$854.60) and the old resettled farms (US$846.55) which had higher but similar mean yield per hectare. The mean land utilisation rate varied significantly (p<0.05) with the land reform model with A2 having highest land utilisation rate of 67%. The A1 and old resettlement households had land utilisation rates of 53 and 46% respectively. Average total revenue varied significantly with the model of land reform. Sex, marital status, age of the household head, education and household size significantly affected land utilisation (P<0.05).**

**Key words:** Land reform, land utilisation, old resettlements, revenue, yield.

## INTRODUCTION

Agriculture accounts for about 30% of Africa's GDP and 75% of total employment (World Bank Development Report, 2008). Consequently, agricultural performance determines Africa's economic performance. Three out of four poor people in developing countries lived in rural areas in 2002 (FAO, 2005). Most depend on agriculture for their livelihoods, directly or indirectly. Hence a more dynamic and inclusive agriculture could dramatically reduce rural poverty, helping to meet the Millennium Development Goal of halving poverty and hunger by 2015 and continuing to reduce poverty and hunger for several decades thereafter. Agriculture alone will not be enough to massively reduce poverty, but it has proven to be uniquely powerful for that task.

The World Bank Development Report for 2008 shows that Sub-Saharan Africa has lagged behind in agricultural performance: rapid yield gains in cereals were realised from 1960 to 2005 in all parts of the world except the sub-Saharan Africa (World Bank Development Report, 2008). Food security remains challenging for most countries in sub-Saharan Africa, given low agricultural growth, rapid population growth, weak foreign exchange earnings, and high transaction costs in linking domestic and international markets. In the 1980s, continuing deterioration of food production in sub-Saharan Africa was caused partially by extended drought and soil degradation (Bole et al., 1994). Ambient temperature, precipitation and soil moisture, as well as frequency of heat waves and droughts, are significant factors influencing crop production in sub-Saharan Africa (Makhado, 1996).

In Zimbabwe for instance, since the implementation of the fast track land reform, the decline in agricultural production was the worst in Sub Saharan Africa. Only 300 of 4,500 commercial farmers remain on farms (Sachikonye, 2005). The eviction of the mostly white farmers has been partly blamed by critics and aid agencies for Zimbabwe's worst famine in living memory,

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which left about two-thirds of the 11.6 million people facing severe food shortage (Chipika, 2006). The main factor which accounts for the widespread poverty is lack of formal employment or poor salaries and as such use of technical inputs is very low due to the fact that the majority of the farmers cannot afford (Sachikonye, 2005). In addition, the erratic rainfall patterns being experienced in Zimbabwe have also contributed to poor agricultural yields hence poverty and food insecurity (Mushunje, 2005).

Although it has been more than two decades since the start of Zimbabwe's resettlement experience, this massive socio-economic change remains relatively unstudied. Such unstudied areas include areas related to the comparison of the productivity and livelihood changes of the resettled farmers of the first phase of land reform with that of the beneficiaries of the fast track land reform programme which kick started in June 2000. This paper seeks to provide micro-evidence on the financial benefit from field crop production by the resettled farmers. The level at which the beneficiaries of land reform are utilizing their land was also determined in this paper. This will enable us to see if land reform beneficiaries are reaping any benefits from the programme.

## MATERIALS AND METHODS

### The study area

The study was conducted in the Mashonaland Central Province of Zimbabwe. It has an area of 28,347 km² and a population of approximately 998, 265 (Census, 2002), representing about 8.5% of the total Zimbabwe population. The population density for Mashonaland central province is about 20 persons per square kilometer and 92 per cent of the population is rural. The area is largely composed of flat and undulating terrain. However some districts such as Mt Darwin, Centenary are mountainous and fall in the Zambezi valley which is a low lying area. The Province mostly lies in the agro-ecological region II, which is good for cropping and intensive livestock production. Rainfall is confined to summer and is moderately high (750 - 1000 mm) in this region (Vincent and Thomas, 1960; Campbell, 2003). The Province also has some small portions falling in regions III and IV which are good for semi-intensive farming and semi-extensive farming respectively (Utete, 2003). In natural region III, rainfall is moderate (650 - 800 mm), but, because much of it is accounted for by infrequent heavy falls and because temperatures are generally high, its effectiveness is reduced. The Province has a total of 712 officially settled farms out of 778 gazetted farms. As at the end of July 2002, 14,756 households had been settled under the A1 Model, while 1,684 had been allocated land under the A2 Model (Utete, 2003).

### Sampling procedure

Shamva District was randomly selected from 6 districts of the 7 that exist in Mashonaland Central Province, Rushinga district was purposively excluded from the population as there are no fast track land reform beneficiaries within this district. In Rushinga there were no commercial farms due to extreme climatic conditions and tsetse fly which resulted in former colonial masters not settling in this area. Communities that benefited from land reform were randomly selected. Stratification was done according to the model of land reform. Three strata were formulated, these included:

- Resettlement scheme: beneficiaries of land reform before 2000
- Fast Track A1 model
- Fast Track A2 model

The reason for this type of stratification is that the land reform emerged from different models and in most cases these models differ on how they are implemented and supported thus might lead to different efficiencies of the resettled farmers. Sample size varied according to the total number of beneficaries that benefited from each of the three models of land reform. Selection of respondents was based on being a land reform beneficiary and farmer's willingness to participate in the research. From the A1, A2 and the old resettlement scheme, 79, 67 and 99 respondents were selected respectively and interviewed at their homesteads by trained enumerators (extension officers) under the supervision of the researcher from June to September 2010. Respondents were household heads. In the absence of household heads, any adult member of the household was interviewed.

### Data analysis and description of variables used in the analysis

Descriptive statistics was applied to the basic characteristics of the sampled households. This employed both frequency and means to describe the data which included data related to religion, age of head of household and crop outputs. The dependency ratio which is an age-population ratio of those typically not in the labor force (the dependent part) and those typically in the labor force (the productive part) was calculated using simple statistics. In published international statistics, the dependent part usually includes those under the age of 15 and over the age of 64. The productive part makes up the population in between, ages 15 – 64. Dependency ratio was calculated using the formula below:

$$(Total)\ Dependency\ ratio = \frac{(number\ of\ people\ aged\ 0\ to\ 14) + (number\ of\ people\ aged\ 65\ and\ over)}{number\ of\ people\ aged\ 15 \rightarrow 64} \times 100 \quad \text{(i)}$$

The effects of model of land reform, gender of the household head, marital status, age of the household head, education, household size, religion, dependence ratio, whether the farmer was fulltime or part-time in farming, experience of the farmers in farming at that environment, total land size owned by the farmers and soil type on yield and land utilization were determined using the GLM procedure of SAS (2003). Significance differences between least-square group means were compared using the PDIFF test of SAS (2003). The linear statistical model used was:

$$Y_{ijklmnopqrst} = \mu + B_i + D_j + E_k + F_l + G_m + H_n + J_o + K_p + L_q + M_r + N_s + O_t + E_{ijklmnopqrst} \quad \text{(ii)}$$

Where

μ = constant mean common to all observations;
$B_i$ = effect of household size ($I$ = ≤ 6, >6);
$D_j$ = effect of age of head of household ($j$ = ≤50,>50);
$E_k$ = effect of gender of head of household ($k$ = male, female);

$F_l$ = effect of marital status ($l$ = Married, Single, Divorced, Widowed);
$G_m$ = effect of religion ($m$ = Christianity, Traditional, Muslim, Other);
$H_n$ = effect of education level ($n$= none, primary, secondary, tertiary);
$J_o$ = effect of model ($y$ = resettlement, A1, A2);
$K_p$ = effect of farmer status ($p$ = full time, part time);
$L_q$ = effect of farm size ($u$ = ≤10, >10);
$M_r$ = effect of dependence ratio (<0.5, ≥0.5);
$N_s$ = effect of years of experience ($s$ = ≤10, >10);
$O_t$ = effect of soil type ($w$ = Clay, loam, Sandy Loam, Clay loam, Sand);
$E_{ijklmnopqrst}$ = random residual error, assumed to be normally distributed

$Y_{ijklmnopqrst}$ = response variable (yield and land utilization). The dependent variable is *Yield*, which is the value of total agricultural output per hectare, in United States Dollars (US$). Land utilisation rate is calculated as a ratio of total cultivated land and total arable land using the formula below:

Land utilization rate = (Arable land cultivated by a farmer in the last season/Total arable land) × 100%

The relationship between yield and land utilization was examined using the Pearson's correlations analysis (PROC CORR procedure of SAS, 2003). Association between response variables that had an effect on either yield or land utilization with all the other response variables was tested using the Chi-square test for association. To find the effect of arable land used and herd size (continuous variables) on yield per hectare and land utilisation the RSREG Procedure of SAS (2003) was used.

## RESULTS

### Farmers' socioeconomic profile

The majority of the households in the resettled areas, A1 (91%), A2 (87%) and the old resettlement areas (70%) were male-headed and at least primary education, with all the households heads in both A1 and A2 having attended at least primary education. However more effort is still needed in providing tertiary education since across all the land reform models, the minority of the interviewed farmers had reached this level as shown in Table 1. The majority of the interviewed land reform beneficiaries were married. A1 land reform beneficiaries had most of the household heads being married (91%), followed by A2 household head being married (78%). Old resettlement land reform beneficiaries had the least number of married household heads.

About 67, 83 and 92% of the farmers in the A1, old resettlement and A2 land reform model respectively, were Christians, 33, 17 and 8% were African tradition worshipers. Most of the interviewees in A1 model (100%); A2 model (76%) and the old resettlement scheme (96%) were full time farmers. Sand-loam was the most popular soil type among all the farms in all the categories with almost 63% of the A2, 39% of the A1 and 38% of the old resettled farms. A2 farms were found to possess only clay-loam and sandy-loam. This means that the farms have good soils for production of field crops like maize, ground nuts and cotton. The mean household size varied significantly (p<0.05) among the land reform models, A2 having higher household size than both the A1 and old resettlement households. No difference was, however observed between the A1 and the old resettlement models respectively.

The mean age of the household heads were similar (P>0.05) for A2 and the old resettlement model, however they both significantly varied with A1 model, having the least mean age of household head of 36.4 years (P<0.05). There was significant difference between the mean land size owned by A2 land reform beneficiaries and both A1 and the old resettled farmers (P<0.05). A2 farmers owned more land than both the A1 and the old resettlement land reform beneficiaries; however land size owned by both A1 and the old resettled farmers was similar (P>0.05).

Experience of land reform beneficiaries in the study area significantly differed from models, having A1 farmers with minimum farming experience and a mean of 5.4 years. The beneficiaries of the old resettlement model had more experience than both the A1 and A2 farmers. The mean head size varied significantly (P<0.05) among the land reform models. A2 farmers had the highest mean number of cattle than the A1 and the old resettled farmers. No difference was, however observed between the A1 and the old resettlement models. A1 and the old resettled farmers diversified more in term of field crop production than the A2 farmers as evidenced by more field crops they grow than the A2 farmers as shown in Table 2. However, no significant differences were observed between the A1 and the old resettled farmers.

### Effect of land reform model on land utilisation and yield

A2 farms had the lowest mean yield per hectare of US$714.80 and significantly differ from A1 and the old resettled farms which had higher and similar mean yields per hectare (Table 3). Though A1 and the old resettled farmers had similar yields per hectare, A1 farmers had the highest yield per hectare of US$854.60 whereas the old resettlement had a mean yield per hectare of US$846.60. The mean land utilisation rate varied significantly (p<0.05) among the land reform models. A2 had the highest land utilisation rate of 67%, whilst A1 and old resettlement households had land utilisation rates of 53 and 46% respectively. No difference was however observed between the A1 and the old resettlement models (P>0.05).

There is a positive insignificant relationship between land utilisation and yield per hectare for all the sampled households. However, the relationship between land utilisation and yield per hectare varied among the models of land reform. For A1 beneficiaries of land reform, yield per hectare and land utilisation had a positive insignificant

**Table 1.** Household characteristics of farmers and soil types.

| Characteristic | Model of land reform | | |
|---|---|---|---|
| | A1 | A2 | Old resettlement |
| Sample size | 79 | 67 | 99 |
| **Gender of household head (%)** | | | |
| Males | 91.1 | 86.61 | 69.7 |
| Females | 8.9 | 3.4 | 30.3 |
| **Marital status (%)** | | | |
| Married | 91.1 | 77.6 | 67.7 |
| Single | 1.3 | 13.4 | 4.0 |
| Divorced | 3.8 | 3.0 | 2.0 |
| Widow | 3.8 | 6.0 | 26.3 |
| **Education (%)** | | | |
| None | 0.0 | 0.0 | 2.0 |
| Primary | 24.1 | 14.9 | 79.2 |
| Secondary | 75.9 | 55.2 | 18.2 |
| Tertiary | 0.0 | 29.9 | 0.0 |
| **Religion (%)** | | | |
| Christianity | 67.1 | 92.5 | 82.8 |
| Traditional | 32.9 | 7.5 | 17.2 |
| **Soil Type (%)** | | | |
| Clay | 29.1 | 0.0 | 27.3 |
| Silt | 15.2 | 0.0 | 17.2 |
| Sandy Loam | 39.2 | 62.7 | 38.4 |
| Clay loam | 7.6 | 37.3 | 6.1 |
| Sand | 8.9 | 0.0 | 11.1 |
| **Level of specialization (%)** | | | |
| Full time farmers | 100.0 | 76.1 | 96.0 |
| Part-time | 0.0 | 23.9 | 4.0 |

**Table 2.** Least square means and standard errors of means of household size, age of household head, landholding, experience of farmer, number of field crops grown and herd size of the land reform beneficiaries.

| Characteristic | Model of Land Reform | | |
|---|---|---|---|
| | A1 | A2 | Old Resettlement |
| Sample size | 79 | 67 | 99 |
| Household size | 5.7 (0.52)$^{a}$ | 9.5 (0.57)$^{b}$ | 6.5 (0.46)$^{a}$ |
| Age of household head | 36.4 (1.26)$^{a}$ | 53.3 (1.37)$^{b}$ | 60.7 (1.13)$^{b}$ |
| Landholding | 5.0 (0.69)$^{a}$ | 39.7 (0.75)$^{b}$ | 5.0 (0.62)$^{a}$ |
| Experience | 5.4 (0.40)$^{a}$ | 11.2 (0.43)$^{b}$ | 26.3 (0.36)$^{c}$ |
| Herd size | 4.1 (9.29)$^{a}$ | 51.4 (10.11)$^{b}$ | 5.3 (8.33)$^{a}$ |
| Number of crops grown | 6.2 (2.98)$^{a}$ | 3.2 (1.33)$^{b}$ | 6.6 (3.11)$^{a}$ |

Means in the same row with different superscripts ($^{a, b, c}$) are significantly different at $P < 0.05$.

relationship (P>0.05). There was a positive significant relationship between land utilisation and yield per hectare for the old resettlement scheme whilst for A2 land reform beneficiaries there was a negative significant relationship.

## Variations of average total cost of production, revenue and profit margins

The average total cost of production for field crops was

**Table 3.** Least square means and standard errors of means of yield and land utilisation from Resettlement, A1and A2 land reform beneficiaries.

| Characteristic | Model of Land Reform | | |
|---|---|---|---|
| | A1 | A2 | Resettlement |
| n | 79 | 67 | 99 |
| Yield(US$)/ha | 854.6 (38.92) [a] | 714.8 (42.26) [b] | 846.6 (34.77) [a] |
| Land Utilisation (%) | 52.5 (2.01) [a] | 67.0 (2.18) [b] | 46.0 (1.80) [a] |

Means in the same row with different superscripts ([a, b, c]) are significantly different at P < 0.05.

**Table 4.** The average costs, revenue and profit margin of field crop production from the old resettlement, A1and A2 land reform beneficiaries.

| Variable | Means (US$)(se) | | | Range | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | OR | A1 | | A2 | | OR | |
| TC/ ha | 758.24 (27.27)[a] | 563.22 (25.87)[b] | 792.63 (29.47)[a] | 330.00 | 1696.25 | 159.00 | 1118.14 | 372.50 | 2955.00 |
| Yield (TR)/ ha | 854.57 (35.79)[a] | 714.78 (33.21)[b] | 846.55 (40.86)[a] | 298.33 | 1811.00 | 249.08 | 1343.33 | 222.50 | 4020.00 |
| Potential Yield/ha* | 816.91 (0.61)[a] | 660.26 (6.60)[b] | 813.87 (0.62)[a] | 809.14 | 827.38 | 520.42 | 786.35 | 809.14 | 854.73 |
| Profit (π)/ha | 96.33 (21.05)[a] | 151.56 (18.18)[b] | 53.92 (12.89)[c] | -200 | 1170 | -88 | 641 | -250 | 1065 |

Note: * Potential yield per hectare was determined using the linear regression model of yield and used arable land based on the assumption that farmers utilise all their arable land for field crop production.

higher (US$4974.47) and significantly different from A1 (US$1772.84) and the old resettlement (US$1732.00. However, the reverse is true for average total cost per hectare. Average total revenue varies significantly among the models of land reform. A2 farmers attained the highest average total revenue of US$6437.89 explicitly followed by A1 farmers who on average had average total revenue of US$2034.98. The old resettlement farmers attained the minimum average total revenue of US$1865.48. There was a significant variation of average profit margins amongst the three models of land reform. The mean profit margins for old resettled, A1, and A2 farmers were US$133.48, US$262.14 and US$1463.42 respectively. An interesting observation was that A1 and the old resettled farmers attained the highest average total revenue per hectare as illustrated in Table 4.

## Factors influencing yield and land utilisation

Land utilisation was not affected by model of land reform, religion, dependence ratio, whether the farmer was full-time or part-time in farming, experience of the farmers in farming at that environment, total land size owned by the farmers, and soil type as shown in Table 5.

Sex, marital status, age of the household head, education and household size significantly affected land utilisation (P<0.05). Males had a significantly higher mean land utilisation rate of 52% than females who had a mean land utilisation rate of 39%. Single households had the least and significantly different land utilisation rate (37.44±10.73) than the married households heads (55.91±9.80), divorced (43.03±11.73) and widowed (46.55±10.37). Older farmers utilise more of their arable land than younger farmers (p<0.05). The mean land utilisation for farmers who were older than 50 years old was significantly higher (49.53±9.85) than of those farmers who were less than or 50 years old (41.94±9.88). Significantly lower land utilisation rate was obtained by farmers that had not accessed any form of education (28.24±15.88). Land utilisation rate however increased with education level. Those that had tertiary education had the highest level of land utilisation (59.41±9.53), closely followed by those that had reached secondary level of education (50.49±9.58) and primary level of education (44.80±9.64). Significantly higher land utilisation rate was observed in bigger households (51.51±9.78) than for smaller households composed of less than 7 members (39.96±9.72). Yield per hectare was not affected by all the factors that were entered in the model which included model of land reform, gender of the household head, marital status, age of the household head, education, household size, religion, dependence ratio, whether the farmer was fulltime or part-time in farming, experience of the farmers in farming at that environment, total land size owned by the farmers and soil type. All these factors fit well in the models as the $R^2$ value of 0.79 is far much closer to 1.

## The effect of arable land used and herd size on yield per hectare and land utilisation

Herd size and size of arable land used significantly affected

**Table 5.** Factors influencing land utilisation by land reform beneficiaries.

| Source | Mean Square | F Value | Pr > F |
|---|---|---|---|
| Model | 402.092207 | 1.42 | 0.2443 |
| Sex | 1150.531537 | 4.06 | 0.0451* |
| Marital Status | 742.183065 | 2.62 | 0.0418* |
| Age | 1049.623167 | 3.70 | 0.0456* |
| Education | 658.490485 | 2.32 | 0.0459* |
| Religion | 28.998724 | 0.10 | 0.7494 |
| Household Size | 5831.158476 | 20.57 | 0.0001* |
| Dependence ratio | 117.235926 | 0.41 | 0.5208 |
| Farmer Status | 52.374002 | 0.18 | 0.6677 |
| Experience | 13.701087 | 0.05 | 0.8262 |
| Land size | 204.278110 | 0.72 | 0.4876 |
| Soil type | 265.908715 | 0.94 | 0.4427 |

*Factor significantly affect land utilisation rate of land reform beneficiaries in Mashonaland Central Province, Zimbabwe.

yields of field crops of the resettled farmers in Zimbabwe negatively ($P<0.05$) whereas the same factors significantly affect land utilisation rate of the resettled farmers positively ($P<0.05$) as illustrated in equations 1 and 2 below. An increase in herd size by 1% results in a decline in yield by 1.10% and a 0.22% increase in land utilisation rate by land reform beneficiaries in Mashonaland central province. When arable land under cultivation is increased by 1%, yield per hectare decline by 15.2% and land utilisation rate rise by 5.05% (Equations 3 and 4). Knowing the value of herd size and land under cultivation, more than 50% of the variances in yield per hectare and land utilisation rate can be explained using all the equations as the $R^2$ values are higher than 0.5.

$$Y_{1\ Xl} = 836.915067\ (24.816671) - 1.097220\ X_1,\ P<0.05 \quad \mathbf{R^2 =} 0.8180 \qquad (1)$$

$$Y_{2\ X1} = 49.237003\ (1.236220) + 0.220844\ X_1,\ P<0.05 \quad \mathbf{R^2 =} 0.6883 \qquad (2)$$

$$Y_{1\ X2} = 885.121710\ (54.532070) - 15.195801\ X_2,\ P<0.05 \quad \mathbf{R^2} = 0.9432 \qquad (3)$$

$$Y_{2\ X2} = 35.521480\ (2.217662) + 5.050230\ X_2,\ P<0.05 \quad \mathbf{R^2 =} 0.7972 \qquad (4)$$

Where

$Y_1$= Yield per hectare = Total Revenue per hectare (US$/ha);
$Y_2$=Land utilisation (%);
$X_l$= herd size (unit);
$X_2$= size of arable land used/cultivated (ha);
() = standard error

To calculate potential yield of the resettled farmers, the linear regression model of yield ($Y_{1\ X2}$) and size of arable land used ($X_2$) was used. This model was used mainly because the size of arable land that each individual farmer had was known. In addition, the $R^2$ value of this equation was higher than the rest of the equations. Knowing the size of arable land each individual farmer had, 94% of the variations in yield can be explained by this model. Assuming that land reform beneficiaries utilise all their arable land, the potential yield per hectare is lower than their actual yield per hectare, as shown in Table 4. Land productivity is declining with an increase in size of arable land used.

## DISCUSSION

The finding that males dominated in the agricultural sector in the studied area concurs with earlier reports (Chawatama et al., 2005; Montshwe, 2006; Musemwa et al., 2010) that highlighted that men are, by custom, traditional heads of households in rural communities in most African societies. In addition, this clearly shows that the effect of rural-urban migration, where the males go to urban areas in search for greener pastures is minimal among the beneficiaries of land reform as the majority of the households were full time farmers and depended on agriculture for their living. This is consistent with the findings of Montshwe (2006) and Musemwa et al. (2007) in their studies in rural communities of South Africa.

As expected, findings from the study reveal that the majority of the household heads were married; this is in line with the findings of Mushunje (2005) in his study on efficiency of land reform beneficiaries in cotton and maize production in Manicaland Province of Zimbabwe. In African societies marriage is perceived to be of high importance and according to Utete (2003), preference on land allocation was given to married household heads;

this may be the reason why the majority of the interviewed household heads were married.

However, there were also a significant percentage of widows in the old resettled farms. The reasons for this are not entirely certain. Traditional arguments tend to favor socio-environmental factors, according to the World Health Organization (WHO, 2004) historically; men have generally consumed more tobacco, alcohol and drugs than females in most societies, and are more likely to die from many associated diseases such as lung cancer, tuberculosis and cirrhosis of the liver. According to Stanistreet et al. (2005), men are also more likely to die from injuries, whether unintentional (such as car accidents) or intentional (suicide, violence, war). In an extensive review of the existing literature, Kalben (2002), concluded that the fact that women live longer than men was observed at least as far back as 1750 and that, with relatively equal treatment, today males in all parts of the world experience greater mortality than females. Of 72 selected causes of death, only 6 yielded greater female than male age-adjusted death rates in 1998 in the United States.

An interesting observation that large farm owners were observed to be having the largest household size concurs with the findings of Mushunje (2005) in his study on efficiency of land reform in cotton and maize production in Manicaland Province of Zimbabwe. A larger family size means that the required labour for field crop production is available; however pressure is set on consumption. The increase in land utilisation per farm as family size increased may reflect a strategy to provide employment for children and older members (especially women) of the extended families. Further, larger households require more cash to pay for school fees and other household expenses and this therefore motivates them to utilise more of their land since the majority of the resettled farmers sorely depend on agricultural production for their living.

The observation that the majority of the household heads had at least primary education concurs with the findings from a study by Nkhori (2004) in communal areas of the Botswana and Binam et al. (2004) in Cameroon. The problem of household heads having never attended school is likely to diminish quite significantly over the years as access to education is improving significantly in rural areas (Montshwe, 2006). Efforts should, however, be made to ensure better access to secondary and tertiary education as the majority of the households have primary education. Many of the existing household heads are elderly and today's youths will have had considerably more basic education by the time they become household heads since they have better access to education nowadays than before. However, the problem that may arise is that most of the youths may be employed in the formal sector and other informal sectors in urban areas where there are bright lights as most of them view agriculture as a dirty business, primitive and old fashioned. This therefore justifies why the small scale agricultural sector is dominated by the old aged. According to Gwaze (2008), there is a gap that will be difficult to fill once the aging farmers are retired, possibly leading to the collapse of small scale agriculture.

The low mean cattle herd sizes observed for A1 and old resettlement areas were similar with the findings of Chawatama et al. (2005) in communal areas of Chikomba, Kadoma, Matobo who observed mean herd size of 5 in aggregate from the three studied communal areas. The observed herd sizes are however far much lower to that reported for other areas of Zimbabwe. Francis and Sibanda (2001) reported that in Nharira-Lancashire communal area of Zimbabwe, over 90 % of the households kept 18 ± 11 cattle. The highest mean herd size of 33 ± 6 was reported by Ndebele et al. (2007) in their study on cattle breeding management practices in the Gwayi smallholder farming area of South-Western Zimbabwe. The lower mean herd sizes observed among the A1 and the old resettlement farms may be attributed to farmers having limited access to grazing land. In addition, the lower mean herd sizes among A1 and old resettlement farms can be attributed to the adequate rain received in the area of study which made crop production a more appropriate agricultural enterprise. Livestock production therefore, was not a priority to the majority of the A1 and old resettled farmers. According to the survey, A2 farmers owned more cattle with an average of 51 cattle per household. The higher mean herd size observed for A2 farmers was due to them having access to their own well developed grazing land. In addition, the majority of these A2 farmers were educated and had well paddocked grazing areas which made good breeding strategies possible resulting in their herd sizes growing at a good rate than small land holders who had access to communal grazing land.

The finding that A2 farms (large farms) had the lowest mean yield per hectare of US$714.80 than smaller farms (A1 and the old resettled farms) concurs with earlier reports (Sen, 1962; Bwiringiro and Reardon, 1996; Newell et al., 1997). Similar findings have come from recent research in the Indian states of Karnataka and West Bengal. In Karnataka, agricultural laborer families who received government-granted house-and-garden plots of only 1/25 acre (0.016 ha or about 1730 square feet) were able to produce most of the family's nutritional needs for vegetable, fruits, and dairy products and obtain cash income equivalent to one fulltime adult wage from plant and animal products on the tiny plot (Prosterman and Hanstad, 2003). Land reform beneficiaries in Karnataka had invested in land improvement measures and raised their land productivity and socio-economic status. In a study typical of this approach, Bwiringiro and Reardon (1996) found that small Rwandan farms achieved three times greater land yields, used four times more labour and had four times the number of plots per hectare that larger farmers did.

The study by Sen (1962) of India's Farm Management Survey observed an inverse relationship between farm size and productivity. Still on the same note, Cornia (1985) argues that high labour use intensities on small farms is mainly found in the land market where small scale farmers face higher effective purchase prices for land. This biased resource position for peasant farmers has several implications about their use of labour vis-à-vis large scale farmers. Small plot holders use labour more intensively for each crop, they use more of the available land, they choose more labour intensive crops, and use their own labour for land improvements. All these implications according to Cornia (1985) lead to the conclusion that small farmers have a higher resource use per unit of land that will in turn result in them getting more returns from farming thereby alleviating rural poverty. In addition, family labour is more efficient than supervised labour; secondly family labour is more motivated than hired labour and this in turn results in small plot holders having more yield per hectare than A2 farmers who also in most cases depend on hired labour.

The observation that A2 farmers utilise more land than both the A1 and old resettlement households deviates from the findings of Moyo (2004) in his study on land utilisation by large scale commercial farmers in Mashonaland Province in Zimbabwe. Moyo (2004) observed that large scale commercial farmers under utilise their land and observed that the total area in Mashonaland amounts to 4.3 million hectares, which constitutes 32% of the overall land owned by the large scale commercial farmers. However, he found that only 10% of this prime land is actually cropped, and this represents 75% of the total area cropped by large scale commercial (LSC) farmers in the country as a whole. The deviation of this study's findings from Moyo's (2004) findings may be due to the government input scheme programme that was available to A2 farmers. For instance, A2 farmers in Zimbabwe were provided with tractors and fuel under the Reserve Bank of Zimbabwe mechanisation programme, this enabled them to utilise most of their arable land. In addition to the tractors, those who did not get tractors had access to the District Development Fund (DDF) tractors. All these strategies created an enabling environment for A2 farmers. In addition, this mechanisation programme resulted in A2 farmers minimising their cost of production per hectare hence the observed results that A2 households had lower costs of production per hectare than A1 and the old resettled households (small farms).

Gender disparities in land access, tenure security and sustainability, have more impact on female-headed farm households (Utete, 2003). The female-headed farm households tend to be poorer and more disadvantaged than households headed by men. In Bangladesh, many female heads of household are either landless or have small, marginal holdings. In Guatemala and El Salvador, many of the farms managed by women are less than a half hectare. In Botswana, female-headed farm households tend to work on less land, have access to less farm equipment, and own fewer cattle and small stock than male-headed households (Katrine and Spurling, 1992). In the Congo, nearly 60% of women cultivate less than 1 hectare of land (FAO, 1995). These findings are similar to what was observed in this study that male headed households utilized land better than female headed households. The main reasons for male headed farms utilizing land better than their female counterparts are similar to the ones found in Botswana. In addition females are involved in many household activities such as child rearing, cooking and general house work, and this may be the reason why they minimally utilise their land for field crop production than male headed households. Most of the land reform beneficiaries depend on animal traction when it comes to cultivation of their fields. In the Limpopo Province of South Africa, Mokoena (1996) found that the use of animal traction depends on the gender of the head of the household. Those households headed by men make significantly more use of animal traction than those households headed by females (Moholwa, 1995). This therefore results in male headed households utilising more of their arable land than female headed households.

Married household heads utilise more of their arable land as also observed in Ghana where household heads that were married had less poverty than single headed households due to factors which Owusu (2008) attributed to combined household income, more labour, more information and knowledge. The observation that older farmers utilise more of their arable land than younger farmers may be due to the fact that older farmers have acquired many assets such as tractors and cattle and have more capital that they have acquired and have better access to aid from non-governmental organizations of agricultural inputs than younger farmers resulting in older farmers utilizing more of their land than younger farmers. In addition, older household heads may also be having children who may be working in various sectors of the economy and may be financing them in agricultural production hence resulting in older households utilizing more of their arable land than younger people. Older farmers are able to utilise most of their available land in agricultural production than younger farmers because they have more access to labour as they have larger families.

As education level increases, the farmers become more knowledgeable on effective land use and consequently increased land utilisation. In addition, the farmers would be able to be employed formally thereby generating income that can be used to sustain increased farming activities. The farmers would also be able to access credit facilities to purchase farming implements and inputs resulting in an increase in land utilisation. Farmers who had at most primary education in most cases are the old aged farmers and they had traditional knowledge about agriculture. Such farmers, however, might not be in a position to adopt new technologies (Agwu et al., 2008) that are meant to improve agricultural production. Educated farmers are more likely to be receptive to new technologies faster than uneducated and the more educated the farmers, the more active and innovative they become.

Herd size and arable land used significantly affect yields of field crops of the resettled farmers negatively. An increase in herd size would mean a corresponding increase in grazing requirements. Depending on the available feed resources, one livestock unit may require more hectarage than the normal 1 LU/ha (Cousins, 1989; Abel and Blaikie, 1989). Taking into cognisance the increased need for grazing land with an increase in herd size, land utilisation for field crop production would suffer as more land would be assigned towards cattle production than field crop production.

According to Swanepoel et al. (2000) and Chimonyo et al. (1999), labour for livestock production in Africa is mainly supplied by female and child labour, who have limited employment options. A similar observation has been made by Gryseels (1988) and Quinsimbing (1994) with respect to labour inputs in livestock production in the Ethiopian highlands. It is also likely that the labour requirements for field crop production is also the same, this therefore results in conflict of labour between livestock production and field crop production. As herd sizes increase, there is a resultant increase in labour needed to look after the increased livestock herd at the expense of field crop production. On the other hand, an increase in arable land use, where labour, capital and all other necessary factors of production remain constant, causes a reduction in efficiency of field crop production due to decline in labour productivity per hectare and consequently, yield of field crops per hectare falls.

Crop production in the resettlements is characterised by use of animal draught power (Mushunje, 2005). In the current study, an increase in herd size resulted in a corresponding increase in land utilisation. However, all other factors constant, an increase in herd size and land utilisation does not mean an automatic increase in efficiency of production. The increased need for labour requirements may reduce the efficiency of land productivity. Arable land use also had a positive effect on land utilisation, meaning that an increase in the size of arable land used would result in an increase in land utilisation. However, an increase in arable land use means that there is an increased need for inputs, labour and other capital which may not be available to the resource poor farmers. Consequently, efficiency of productivity decreases. Bhalla and Roy (1988) argue that, if land quality and farm size are inversely correlated and farm size and cultivated area are directly correlated, then excluding land quality from regressions of land yields on cultivated area would bias the estimated coefficient of cultivated area downwards. But this would bias only if the soil quality differences were not due to investments made by the farmers themselves.

Thus agro-climatic conditions and soil quality are crucial determinants of agricultural productivity, as well as measures of farmers' investment in soil quality must be included in investigations of productivity (Nuppenau, 2009). Attempts to incorporate soil quality into empirical investigations of the inverse relationship have mixed results. Newell et al. (1997) argue that farms are smaller in fertile regions than in less fertile regions and as a result of this, outputs per hectare are higher on small farms. However while land quality explains some of the inverse relationships, it does not explain all of it. Both natural soil quality and investments in soil quality contribute to productivity (Carter, 1994).

## Conclusion

Small plot holders have higher yields per hectare (though they have a lower land utilisation rate) than larger plot holders who have a higher land utilisation rate. As herd size increases, the yield of field crops of the resettled farmers in Zimbabwe decreases. However, an increase in herd size results in an increase in utilisation of arable land by the resettled farmers in Zimbabwe. There is also an inverse relationship between size of arable land used and yield of field crop per hectare. To increase national agricultural land productivity, beneficiaries of land reform should be allocated small farms as they produce more output per hectare than large farms. In addition, farmers can utilise all their land if they are allocated small farms based on their household size. Preference must be given to married household heads when allocating land as married household heads have better yields per hectare than single headed households. Educating land reform beneficiaries using informal methods is of paramount importance and should be included and prioritised in the budget of the Department of Agriculture.

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