

**Genetic Resource Base, Phenotypic Characters and Herd Dynamics of Indigenous  
Pigs in a Semi-arid Smallholder Farming Area of Zimbabwe**

**By**

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(BSc. Agric. Hons. University of Zimbabwe)

A thesis submitted in partial fulfillment of the requirements of the degree of  
Master of Science in Animal Science

**Department of Animal Science**

**Faculty of Agriculture**

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## ABSTRACT

### **Genetic Resource Base, Phenotypic Characters and Herd Dynamics of Indigenous Pigs in a Semi-arid Smallholder Farming Area of Zimbabwe**

By

George Chiduwa

The objective of the study was to determine the genetic resource base, phenotypic characters and breeding systems of local pigs in Chirumanzu district, Zimbabwe. A survey, measurement of phenotypic traits of local pigs and a longitudinal study of pig household herds in randomly selected villages of Chinyuni ward were used as study instruments. Women owned 89.9% of the household pig herds. Local breeds contributed 92.2% of the sample population with crossbreeds and exotics (Landrace and Large white) contributing 4.5% and 1.8% respectively. The following traits were selected for; body size (94.3%), body conformation (24.4%) and short snout (5.1%) in boars, and linear type traits (58.2%), litter size (32.1%), short snouts (6.4%) and litter index (9.1%) in females. The percentages represent the number of households who selected for each trait. Litter index was  $1.5 \pm 0.50$ , litter size was  $7.7 \pm 1.83$  and sows were culled at parity of  $2 \pm 1.52$ . Fore-quarters: hind-quarters ratio were  $1.0 \pm 0.02$  for boars and  $1.0 \pm 0.01$  for sows. It was found that 46.2 % of the pigs had 8 teats and, 94.9 % were lop eared. Pigs were black (56.4 %), brown (26.6 %) and 17.9 % black and brown. Village had an effect on household herd size ( $P = 0.002$ ) while month ( $P = 0.213$ ) and access to irrigation ( $P = 0.066$ ) did not. Village had an effect on pig production potential (PPP) ( $P = 0.01$ ). Access to irrigation affected PPP ( $P = 0.028$ ) but had no effect on pig production efficiency (PPE) ( $P = 0.532$ ). Household PPE was however affected by the interaction of village and month ( $P = 0.043$ ). Local pigs in the area are a result of both natural and deliberate selection hence their phenotypic characters may differ with those of other local pigs. Pig herd size, production potential and production efficiency were dynamic and affected by many factors.

## **DEDICATION**

This work is a tribute to my family for love and support you have always given, to rural livestock keepers who continue to value local animal genetic resources and to the almighty who makes all things possible.

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## **LIST OF ABBREVIATIONS**

AnGR = Animal Genetic Resources

AREX = Department of Agricultural Research and Extension

CSO = Central Statistics Office

DAD = Domestic Animal Diversity

DFID = Department for International Development

EU = European Union

FAO = Food and Agriculture Organisation of the United Nations

IUCN = World Conservation Union

LPD = Department of Livestock Production and Development

PIB = Pig Industry Board

PPP = Pig Production Potential

PPE = Pig Production Efficiency

SAS = Statistical Analysis System

SPSS = Statistical Package for the Social Sciences

VIDCO = Village Development Committee

## CHAPTER 1

### 1 INTRODUCTION

Approximately 70% of the world's rural poor and an estimated 300 000 households in Zimbabwe have livelihoods based on livestock production (Drucker and Anderson, 2004; Food and Agriculture Organisation (FAO), 2005). Pigs in smallholder farming areas of Zimbabwe are an important source of cash and meat. Most resource poor farmers rear indigenous pig genotypes. Use of these breeds improves sustainability of agriculture as they have various useful attributes that contribute to rural livelihoods. These local breeds are, however, being lost through crossbreeding, replacement with exotic breeds and neglect.

In Zimbabwe, there are about 70 000 indigenous pigs, which are generally known as Mukota (Central Statistical Office (CSO), 2004). They are adapted to the harsh tropical environment in terms of heat stress, disease challenge and poor nutrition. They thus have a comparative advantage over exotic breeds in that they can survive and breed in adverse nutritional, climatic and unhygienic conditions which testify to their resistance and tolerance to diseases and parasites (Holness, 1991; Zanga *et al.*, 2003). Livestock of different characteristics, and hence outputs suit differing local community needs. Livestock diversity thus contributes in many ways to human survival and well-being, including contribution to supporting sustainable agricultural development pathways (Drucker and Anderson, 2004). It is, therefore, important to conserve local animal genetic resources (AnGR) and promote their sustainable use.

Modernisation of the livestock industry and the need for productive animals has been accomplished through breed substitution, crossing or upgrading with exotic breeds (Mhlanga, 2002). As a result, there has been a decline in the population size of local animal breeds like the Mukota pig and loss of important genetic variation. Remaining local AnGR is required to meet the food needs of the resource poor smallholder farmers through conservation and utilisation.

The conservation of the genetic resources of the Mukota pigs requires data, such as measures of breed performance parameters, characterisation of the actual and potential breeding systems, uses of pigs, farmer trait preferences and population sizes. The data can be used in the assessment of breeding systems and economics of conserving the Mukota pig. Such records, however, do not exist in the smallholder sector and are required for breed identification and conservation. Setting up such a database is the first step in conserving the AnGR of the Mukota pig.

The broad objective of this study was to determine the genetic resource base, breeding patterns and herd dynamics of indigenous pigs in a semi-arid smallholder farming area of Zimbabwe.

### ***1.1 Objectives***

The objectives of this study were:

1. to evaluate rural pig production and the importance of local pigs to the livelihoods of smallholder farmers in a semi-arid area of Zimbabwe;
2. to characterise the indigenous pigs in a semi-arid area of Zimbabwe using phenotypic parameters; and
3. to determine the dynamics household herd sizes, production potential and production efficiencies of indigenous pigs in a semi-arid smallholder farming area of Zimbabwe.

## CHAPTER 2

### 2 LITERATURE REVIEW

#### 2.1 Introduction

Local livestock genetic resources are important to smallholder farmers due to the contribution they make to sustainable agriculture. A combination of high population growth rate and the desire for higher standards of living is putting pressure on African livestock owners and policy makers to increase production (Rege *et al.*, 1992). This, coupled with the intensification of livestock production systems in the west and the replication of these animal farming models in other parts of the world, has led to a concentration on a limited number of livestock breeds (Drucker and Anderson, 2004). The result is the substantial erosion of local AnGR. There is urgent need to register, improve and preserve local breeds such as the Mukota. Maintaining animal genetic diversity is crucial if productivity and food security are to be improved in smallholder farming areas of Zimbabwe.

Zimbabwe has a rich heritage of indigenous farm AnGR that has served the country well in the past. The Mukota pig is one such genetic resource that has been neglected as most pig research has focussed on imported pig genotypes that apparently cannot be sustained under smallholder farming conditions (Mhlanga, 2002). The high nutrient requirements and the need for intensive management systems for imported genotypes make them unsuitable for resource-poor rural farmers (Mushandu *et al.*, 2005). However, inadequate attention has been given to evaluating African AnGR like the Mukota pig thus no realistic and optimum breeding goals have been set.

Almost two billion people in the world depend on livestock to provide part or all of their daily needs (Anderson, 2003). Pig rearing in smallholder farming areas plays a key role in sustainable agriculture as it:

- provides meat for consumption and cash income from sales;
- provides buffer stocks or savings when other farm activities do not provide the returns required;



- fulfills social and cultural functions through livestock ownership;
- captures benefits from communal property through such processes as transfer of nutrients from common land to private crop land as manure; and
- inputs for crop production.

## ***2.2 Farm Animal Genetic Resources and Sustainable Agriculture***

Many of the world's poor that live in low potential and unfavourable agricultural areas depend directly upon genetic, species and ecosystem biodiversity for their livelihoods (Anderson, 2003). Animal genetic diversity and variability in Africa plays a vital and integral component in the complex, diverse and risk-prone livelihoods of smallholder farmers. The conservation and sustainable utilization of local AnGR that are flexible, resistant and diverse is important to rural livelihoods.

There is an opportunity to better utilise local AnGR in Africa and the developing world. But, to do this it is essential to characterise what exists and find ways of conserving the genetic diversity with the aim of utilisation (Fitzhugh, 1992) as conservation without use is expensive. In order to assess the importance of AnGR as distinct from livestock *per se*, for sustaining and improving the livelihoods of the poor, the factors that differentiate between species and breeds in terms of functions that animals fulfil in livelihoods and household economies need to be better understood (Anderson, 2003).

If AnGR conservation is to make a contribution to improving the livelihoods of poor livestock keepers, the relative importance of AnGR from the livestock keeper's perspective should be appraised (Anderson, 2003). This will help in maintaining and enhancing AnGR best suited to improving the livelihoods of the poor and ensuring equitable access to these resources.

Sustainable pig breeding programmes for the poor should be based on local animals that are adapted to the local environmental conditions. This is because breeds adapted to local conditions are supposed to be superior to imported ones (Drucker and Anderson, 2004). There is need to identify pig gene pools that are rare, threatened or are at risk of extinction as these might be vital in the future due to possible changes in

climates, diseases, consumer tastes and production systems (Anderson, 2003). When economic resources are scarce, as is usually the case, it is essential to prioritise populations for conservation. From a livelihoods perspective, identifying and addressing the AnGR requirements of poor livestock keepers is important (Anderson, 2003). The decisions of where to allocate resources should be based on information that ensures, to the greatest degree possible, the future viability and success of the preserved populations.

### **2.3 Domestic Animal Diversity**

Domestic Animal Diversity (DAD) is defined as the spectrum of differences within each breed, and across all breeds within each domestic animal species, together with the species differences (Fitzhugh, 1992). Livestock diversity refers to about 3,500 livestock breeds developed from a small number of domesticated animal species (Kohler-Rollefson and McCorkle, 2000). Domestic animal diversity and its conservation are developing into a major concern for most of the players in international livestock research including FAO. This is after the realisation that different livestock breeds suit different environments and thus production systems (Anderson, 2003). Local pigs are suitable or optimal for smallholder production therefore maintaining genetic diversity within the pig species will be useful to sustainable agricultural development and improving rural livelihoods.

On a world basis, there are a large number of breeds available to the swine industry. Ellis *et al.* (1997) reported more than 370 pig breeds, about 70 important numerically or historically and over 300 minor, new or disappearing breeds. An estimated 32 percent of livestock breeds worldwide are at risk of becoming extinct (Drucker and Scarpa, 2003). The percent at risk is expected to increase as the rate of extinction has been noted to be on the increase.

The loss of DAD in the developing world seriously reduces the potential to alleviate poverty, improve food security and promote sustainable agriculture (Drucker and Scarpa, 2003). Local pigs fulfill many functions that alleviate poverty, improve food

security and promote sustainable agriculture in smallholder farming areas. Table 2.1 highlights some of the functions of pigs that make them suitable to a particular system of production and differentiates pig breeds.

## **2.4 Pig Production Systems in Zimbabwe**

The Zimbabwean pig industry has undergone marked transformation from an industry that was the preserve of large scale commercial farmers delivering their pigs for slaughter and processing to a monopoly, the Pig Co-operative (COLCOM), to one today where COLCOM slaughters 70 percent of the total pigs and the other 30 percent is slaughtered by smaller abattoirs supplied mostly by small producers (Pig Industry Board (PIB), 2004). Smallholder farmers therefore have an opportunity to benefit from the growth in their market stake and this can be done by improving the production of local pigs that are already adapted to smallholder environment.

Pig production grew by 5-10 percent per year since 1980 except in drought periods (1982-3, 1992-3). Pig production has been noted to benefit from national surpluses in maize and soyabeans. The number of pigs slaughtered per year decreased from 250 000 to 120 000 to 150 000 between 1995 and 2003. Exports by the COLCOM over the five years prior to 2004 averaged about 21 percent of all pigs slaughtered even on a declining production base (PIB, 2004).

### **2.4.1 Pig production in smallholder farming areas**

Pig productivity in smallholder areas of Zimbabwe is generally lower than in the commercial sector. Smallholder pig production is just as rational as large scale or commercial pig production, although subsistence rather than production for markets is the major thrust of smallholder farmers (Bayer *et al.*, 2003). Productivity of pigs by smallholder farmers is affected adversely by the seasonal fluctuations in feed supply (Mashatise *et al.*, 2005), use of the free ranging system by smallholders and poor housing that fails to protect the pigs from bad weather particularly during the rainy season (Holness, 1991). During confinement, in the cropping season the pigs are given feeds such as maize, coarse maize meal, maize husks, green maize, kitchen waste,

**Table 2.1 Livelihood functions of pigs and factors that differentiate between breeds**

| Livelihood function                                                                                     | Factors that differentiate between breeds                                                                                                              |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Regular cash income from sales of pigs or their products                                                | Consumer preferences for products from certain pig breeds can make them pay more for a certain product.                                                |
| Regular cash income from sales or hiring of animals                                                     | Certain breeds with desired characteristics (size, power, docility), and adapted to environment (heat tolerance, walking ability, water requirements). |
| Non-income functions e.g. savings, insurance, collateral for loans, capital accumulation, buffer stocks | Survivability of breed includes disease resistance and climatic tolerance. Reproductive rate is important for accumulation of assets.                  |
| Inputs and services to crop production                                                                  | Certain services best provided by breeds with required characteristics and adapted to environment.                                                     |
| Food (meat) for keepers                                                                                 | Productivity, capacity and reproductive rate.                                                                                                          |
| Social and cultural functions that provide status and identity                                          | Appearance traits usually important.                                                                                                                   |

Source: Anderson (2003).

vegetable waste pumpkins, groundnut shells, fruits, weeds and brewers waste (Scherf, 1990).

## **2.5 Role of Local Pigs**

Pigs have been used for thousands of years by man as a source of food, tallow and many other products (Ellis *et al.*, 1997). Indigenous pigs also have multiple functions and purposes that fulfill many roles for smallholder rural farmers (Anderson, 2003). It still remains common in underdeveloped countries for a family to have at least one pig fed on left-over food from the household and other material as it was in developed nations when pigs were domesticated (Ellis *et al.*, 1997).

Local pigs fulfill many livelihood functions and that include. Cash from sales of animals or meat. This money is used for education, health, shelter and clothing. Use as buffer stocks when other agricultural activities, like cropping enterprises, do not provide returns required. They also function as inputs and services for crop production to capture benefits from common property rights e.g. nutrient transfer through foraging on common land and manure used on private crop land; and to fulfill the social cultural functions through which livestock ownership provides status and identity (Anderson, 2003).

### **2.5.1 Socio-economic functions**

Pigs are normally sold when there is an urgent need for cash, such as paying for school fees for children or sending the sick to hospitals. Pigs are also used as a means to generate and accumulate capital (Mashatise *et al.*, 2005), as they can reproduce and multiply at a higher rate than most domestic livestock. Pigs, like other domesticated livestock species, are kept as inflation-proof and productive investments that can be liquidated in times of need. Pigs are also important in diversification of production. They, therefore, act as a buffer to crop yield losses caused by droughts or excess rain.

Pigs form integral components of mixed crop-livestock farming systems. They provide manure or cash for the purchase of inputs for crop production. They also allow the poor

to obtain benefits for their families from exploiting common property (Anderson, 2003). Local pigs can also utilise resources that have few alternative uses, such as brewer's waste, kitchen swill and agricultural by-products. The traditional role of pigs according to Ellis and co-workers (1997) was to convert waste and by-products from the human food chain into a range of valuable products.

### **2.5.2 Food security roles**

Pigs are important for the provision of meat. Mashatise (2005) reported that over 70 percent of farmers in northeastern Zimbabwe kept pigs primarily as a source of meat. Ndiweni and Dzama (1995) also indicated that meat from local pigs is organoleptically more acceptable in Zimbabwe than meat from imported pigs. The potential demand for pig meat exceeds the current supplies (Ellis *et al.*, 1997). Smallholder farmers also value fat that is obtained after slaughtering pigs which they normally use for cooking (Ndiweni and Dzama, 1995; Mashatise, 2005). The manure that is produced by pigs can be used as fertilizer for crop production (Mashatise, 2005).

### **2.5.3 Cultural and ceremonial functions**

Ownership of local pigs by smallholder farmers fulfils social and cultural functions as they provide security and self-esteem to rural farmers (Anderson, 2003). They give status and prestige to the owners. Pigs are also slaughtered at ceremonies, rituals and other social gatherings (Bayer *et al.*, 2003; Mashatise, 2005). Though some societies in Africa might accept pigs as dowry, it is taboo in Zimbabwe (Mhlanga *et al.*, 1999).

## **2.6 Attributes of Local Pigs**

In developed nations pigs are kept under intensive systems that make impressive outputs. These pigs are bred solely for high productivity, without regard to other fitness traits such as disease resistance (Kohler-Rollefson and McCorkle, 2000) resulting in breeds that are less hardy and far more vulnerable to disease. Consequently, they require high veterinary and other inputs such as special feeds, expensive housing, and sophisticated management, unlike local pig breeds.

Industrial breeds' fertility and reproductive performance have been compromised to such an extent that they often have difficulty mating, giving birth, and mothering their young (Mhlanga *et al.*, 1999; Drucker and Anderson, 2004). On the other hand, local or unimproved pigs still have all these attributes that exotic pigs have lost. They mature early reproductively and have good mothering ability (Mhlanga *et al.*, 1999; Holness *et al.*, 2005)

Local pigs are adapted to the low-input and medium-input environmental systems. It has been reported that local pigs have enhanced abilities to utilise fibrous feeds compared with imported genotypes, such as the Large White (Ndindana *et al.*, 2002). It is probable that the poor husbandry practices in the communal areas resulted in the enlarged caeca (Kanengoni *et al.*, 2002) as an adaptation to digest and gain nutritional benefit from fibre. The small body size of most of the local pigs also means that these pigs have low maintenance requirements. It has also been reported that local pigs are better able to utilise red sorghum than imported exotic pigs (Mushandu *et al.*, 2005). In addition, they are better able to tolerate internal parasites than exotic pigs (Zanga *et al.*, 2003).

Mukota pigs can easily survive under unhygienic conditions, which testify to their resistance and tolerance to diseases and parasites. For example, Zanga *et al.* (2003) reported that Mukota pigs resist infection by *Ascaris suum*. In addition, the meat from Mukota pigs has exceptional organoleptic properties and is popularly known as "sweet" pig-meat (Ndiweni and Dzama, 1995; Mashatise *et al.*, 2005) in Zimbabwe.

## **2.7 Breed characterisation**

The largest number of domestic livestock breeds is found in the developing regions of the world (Notter, 1999). A breed is defined as a group of animals with a uniform, heritable appearance (Ellis *et al.*, 1997). The main characteristics that distinguish breeds are aspects such as coat colour (hair and skin colour in pigs), morphological properties such as ear size and shape and body conformation (Ellis *et al.*, 1997).

Livestock breeds in developing nations have been less thoroughly characterised (Notter, 1999), if they have been characterised at all.

There are three levels of breed description, varying from the general to the specific that can be used (Matheron and Planchenault, 1992). The first level is the macro stage. This uses a survey methodology to obtain basic information on the physical description of breeds (Matheron and Planchenault, 1992; Lebbie and Kamau, 2001). This technique allows for swift implementation as well as for use on large animal populations. The technique is important as it gives among other things the probable trend in animal population structure and development and may guide choice of subsequent decisions pertaining to preserving an endangered breed.

The second level is the meta stage. It is based on a monitoring of on-farm husbandry activities (Matheron and Planchenault, 1992). This method requires data of the highest quality and requires the researchers to embark on a continuous data collection process for 2-5 years to enable the qualification of an animal population independently from time or geographical location (Matheron and Planchenault, 1992). The information given by this stage is related to production performance of the breed and thus measurements can take place at research stations (Lebbie and Kamau, 2001).

The third level is the micro stage. It is based on selected methods that can be used to gain knowledge of the genome of individual animals within a population (Matheron and Planchenault, 1992). This level involves use of statistical modeling methods, quantitative genetics and tools for measuring factorial genetics that require both high level of investment and technological input (Lebbie and Kamau, 2001). Due to high cost of methods involved and the difficulty involved in analyzing appropriate biological samples using advanced techniques only a small number of animals can be covered.

When considered alone each level is of value but the sum of all allows each to reach its highest level of effectiveness (Matheron and Planchenault, 1992) and the objectives that the international community have set on inventory of animal genetic resources can be met.



## **2.8 Conclusion**

Many of the animal genetic resources most important to the poor are not improved breeds, but local breeds that still have important adaptation traits to unfavourable environments and that are able to thrive on low external input-type management. The sustainable livelihoods approach can be used to analyse the well-being objectives that people aspire to, the resources or assets they have access to, and the way in which they use those assets to achieve their objectives. It is important that base information on local pigs be made available to all institutions and stakeholders so that options available for resource use are known to communities that directly benefit from them. Animal genetic resources conservation for sustaining livelihoods needs a holistic approach to breed attributes that recognize the array of contributions livestock make to livelihoods and breed characteristics related to these.

Sustainable pig breeding programmes for the poor should be based on local animals that are adapted to the local environmental conditions. There is need to identify pig gene pools that are rare, threatened or are at risk of extinction and are reared by locals as these might be vital in the future due to possible changes in climates, diseases, consumer tastes and production systems.

## CHAPTER 3

### **3 Local pig genetic resources, production and contribution to smallholder agriculture in a semi-arid farming area of Chirumanzu, Zimbabwe**

#### **3.1 Abstract**

This study was undertaken to assess genetic resources, production and contribution to smallholder agriculture in the semi-arid farming area of Chirumanzu, Zimbabwe. Mixed farming was common in the area and more than two livestock species were kept by each household. Women owned 89.9% of the household pig herds with 92.2% of the household herds being local breeds, 4.5% crossbreeds and 1.8% exotic breeds. Pigs were kept for meat, cash, manure and use in social functions. Households selected pigs for body size (94.3%), body conformation (24.4%) and short snout (5.1%) in breeding boars, while they selected for linear type traits (58.2%), litter size (32.1%), short snouts (6.4%) and litter index (9.1%) in breeding females. Litter index was 1.5, litter size was 7.7 and sows were culled at parity 2. Most smallholder farmers in Chirumanzu rear local pig breeds. These pigs fulfill many roles related to smallholder agriculture though it appears their production is lower compared to commercial pig production.

#### **3.2 Introduction**

Local livestock are important to livelihoods of smallholder farmers in semi-arid areas. In Africa, Asia and the developing regions of the world, the poor and the landless derive a higher proportion of household income from livestock sources than do other households (Anderson, 2003). Local pigs, generally known as Mukota, predominate pig production in smallholder farming areas of Zimbabwe. The large population of local pigs in communal areas shows their contribution and potential to improve rural livelihoods (Mhlanga *et al.*, 1999).

The survival and existence of local pigs is threatened by several factors. Intensive selection for bio-economic efficiency has led to the loss of local breeds with their

adaptive traits (Anderson, 2003). The hegemony of breeding companies and policies of upgrading and substitution of local genotypes with imported breeds and the promotion of commercial production, which tends towards uniformity of inputs, resources and outputs, are the other causes of genetic erosion. Livelihood-oriented systems, on the contrary, thrive on diversity (Drucker and Scarpa, 2003). Cultural erosion has also led to loss of traditional animal husbandry practices. Genetic erosion can only be curbed after characterisation of the threatened genetic resources and the production systems of the local people who still maintain the local AnGR. Local pigs are kept under free range during the dry season and in pig houses or fold yards during the rain season. Their survival under the unhygienic conditions would testify to their disease tolerance (Mhlanga *et al.*, 1999). Attributes that make local pigs suitable for smallholder production include; survival on poor nutrition, heat tolerance, and small body sizes that have low maintenance requirements (Holness, 1991).

An improvement in pig productivity, especially in the rural sector, could improve the livelihoods of the resource-poor rural farmers (Hall, 1998). There is, however, little information on how pigs under the traditional system are raised. To design intervention strategies that lead to sustainable development and improve well being and livelihoods of the poor, it is essential that local pig genetic resources, their breeding systems and contribution to the livelihoods of smallholder farmers are known. This study was, therefore, undertaken to establish local pig genetic resources, breeding systems and contribution of local pigs to the livelihoods of smallholder farmers in the semi-arid farming area of Chirumanzu, Zimbabwe.

### **3.3 *Materials and Methods***

#### **3.3.1 Study site**

Chinyuni ward of Chirumanzu district in Zimbabwe, which is 290 km South-east of Harare, off the Harare-Masvingo highway, was used for the study. Chirumanzu is located at 19°S and 31°E and lies at an altitude of 1300 to 1440 m above sea level. The district lies in Natural Region III, an agro-ecological zone where farming operations are extensive (CSO, 2004). The district receives 650 to 800 mm annual rainfall. Mean

maximum temperature ranges from 22°C to 32°C in the cold and hot seasons, respectively. Periodic dry spells are common during the rainy season. Typical of most rural areas of Zimbabwe, agricultural production in Chirumanzu comprises of a mixture of crop and livestock activities under smallholder management. This site was selected with the help of the Department of Agricultural Research and Extension (AREX) and the Department of Livestock Production and Development (LPD) officials because of the large numbers of indigenous pigs found in the area.

### **3.3.2 Introductory visit**

Before the study commenced a visit to the study area was undertaken. The purpose of the visit was to introduce the research team and objectives of the research. Key informants and local leadership in the area were met first. These included officials from AREX and LPD, the local leadership that included headmen, kraal-heads and councilors. Smallholder farmers with pigs in randomly selected wards of Chirumanzu district were then visited to pre-test the survey questionnaire and for feasibility analysis. The objectives were:

1. To introduce the research team and explain the purpose of the study, and
2. To obtain an overview of the area before mapping out the area for the determination of socio-economic importance of pigs, breeding patterns and phenotypic characters of the indigenous pigs.

### **3.3.3 Selection of participants for baseline surveys**

Ten villages were randomly selected from Chinyuni ward of Chirumanzu district and used for the surveys. Only farmers who owned pigs and were willing to participate in the study were considered for semi-structured interviews. At least six semi-structured questionnaires were administered to each village of an average of 15 households and this gave a total 79 questionnaires in the 10 villages. A village normally has 100 households under the government Village Development Committee (VIDCO) systems but in this case traditional villages were considered. The distribution of households per village is shown in Table 3.1.

**Table 3.1 Number of households and percent contributions in the Chinyuni ward  
villages that participated in survey**

| Village name | Number of households | Percent (%) |
|--------------|----------------------|-------------|
| Gumbira      | 8                    | 10.1        |
| Hoto         | 8                    | 10.1        |
| Machekera    | 7                    | 8.9         |
| Mada         | 11                   | 13.9        |
| Madamombe    | 6                    | 7.6         |
| Matavire     | 6                    | 7.6         |
| Mazarire     | 7                    | 8.9         |
| Mberikwazvo  | 9                    | 11.4        |
| Vengai       | 9                    | 11.4        |
| Vurayai      | 8                    | 10.1        |
| Total        | 79                   | 100         |

### **3.3.4 Questionnaire administration**

Semi-structured questionnaires were used as survey instruments to investigate demographics, extension and education support characteristics, herd structure, sow productivity, boar selection, herd dynamics and geographic location of the selected households.

### **3.3.5 Statistical analyses**

Household characteristics, herd composition and participation of the different gender groups in local pig production were analysed using the descriptive statistics procedure of the Statistical Package for the Social Sciences (SPSS) (1999). Chi-square (SPSS, 1999) analysis was used to test for association between household size, ownership, and sex of household head on herd size.

## **3.4 Results**

### **3.4.1 Household demography**

Each household had, on average  $6.02 \pm 2.68$  members. Females headed 22.8 percent of the households while 77.2 percent were headed by males. The age of household head ranged from 27 to 80 with, on average, each household head being  $50.3 \pm 12.78$  years of age. Only 20.3 percent of the household heads were 39 years or less while 30.4 percent were 60 or more years old. Seventy seven, two of the household herds were married, 20.3 percent widowed and 2.5 percent divorced. Average arable land sizes were  $2.5 \pm 0.78$  ha per household.

### **3.4.2 Ownership, function and production of local pigs**

The average number of different livestock species per household is given in Table 3.2. Women owned 89.9 percent of household pig herds owned by women. They were also responsible for the general management of the household pig herd, with 88.6 percent, 6.3 percent and 5.3 percent representing the women, men and children, respectively, that took part in feeding, construction of pig houses and other management duties.

**Table 3.2: Descriptive statistics of different livestock species owned by households in Chirumanzu**

| Livestock species | n  | Minimum | Maximum | Mean | Standard deviation |
|-------------------|----|---------|---------|------|--------------------|
| Pigs              | 79 | 1       | 11.0    | 3.3  | 2.73               |
| Goats             | 79 | 0       | 16.0    | 2.5  | 3.24               |
| Cattle            | 79 | 0       | 24.0    | 5.8  | 5.45               |
| Chickens          | 79 | 0       | 20.0    | 6.7  | 5.56               |
| Sheep             | 79 | 0       | 8.0     | 0.1  | 3.24               |
| Turkeys           | 79 | 0       | 9.0     | 0.4  | 1.58               |
| Guinea fowl       | 79 | 0       | 3.0     | 0.1  | 0.61               |
| Donkeys           | 79 | 0       | 5.0     | 0.4  | 1.05               |

n number of households

The main reasons for keeping pigs in Chirumanzu district were for family consumption as meat, to provide manure for crops, to get cash from sales and for use in cultural and social functions. Table 3.3 shows the percentage of households that kept pigs for each of the four reasons.

Most households reared local pig breeds, with 92.9 percent rearing local pig breeds, 1.8 percent exotic pig breeds (Landrace and Large White) and 4.5 percent crossbreeds. Breeding pigs, mainly gilts and boars were sourced from the household herd (21.1 percent), village herd (52.6 percent) and outside the village (26.3 percent). The majority of farmers selected pigs for breeding purposes, with 87.7 percent selecting breeding females and 91.1 percent selecting breeding boars. Table 3.4 shows the percentage of households that selected a particular trait in breeding females and boars.

The chi-square test of association revealed that the number of pigs in household herd were independent of the sex of household head ( $P = 0.49$ ), marital status of household head ( $P = 0.83$ ), age of household head ( $P = 0.78$ ) and total number of family members in household ( $P = 0.50$ ). The number of pigs per household herd was however dependent on village ( $P = 0.01$ ).

The majority of households (98.4 percent) reported that culling was performed to mitigate the adverse effects of feed shortages especially in the dry season. The pig type culled first in times of feed shortages according to 54.9 percent of the households was the boar, while 30.1 percent did not cull at all. Only 5.4 percent and 3.3 percent of the households first culled male piglets and second parity sows, respectively. Breeding/replacement females (sows and gilts) were culled last by 48.5 percent of the households. Male piglets were culled before female piglets with 11.7 percent of households reporting they culled female piglets last and 9.7 percent of household reporting they culled male piglets last.



**Table 3.3: Function of local pigs**

| Functions of pigs           | Percentage of farmers who kept pigs for each reason |
|-----------------------------|-----------------------------------------------------|
| Consumption (meat)          | 98.7                                                |
| Manure for crops            | 97.5                                                |
| Cash from sales             | 91.1                                                |
| Cultural and social reasons | 11.4                                                |

**Table 3.4: The percentage of households that selected for a particular trait in breeding pigs**

| <b>Trait</b>       | <b>Percentage of households that selected for the trait</b> |
|--------------------|-------------------------------------------------------------|
| <b>Sows</b>        |                                                             |
| Litter size        | 32.1                                                        |
| Linear type traits | 58.2                                                        |
| Mothering ability  | 29.2                                                        |
| Litter index       | 9.1                                                         |
| Short snout        | 6.4                                                         |
| <b>Boars</b>       |                                                             |
| Body size          | 94.3                                                        |
| Body conformation  | 24.4                                                        |
| Short snout        | 5.1                                                         |

Most households (54.4 percent) reported that local pig breeding was seasonal. Eighty one percent of the farmers reported that pigs were bred in the dry season while 19 percent either bred in the wet season or had no preferred breeding season. Descriptive statistics for pig production are shown in Table 3.5.

### **3.5 Discussion**

The high percentage of male-headed households in the rural community under study was expected. That most decisions were made by males was also expected. This is because rural Zimbabwe remains a largely patriarchal society (Mashatise *et al.*, 2005; Muchadeyi *et al.*, 2005). The outcome that household pig herd size was independent of the sex of household head can be explained by the fact that women owned the household herd and they were responsible for its general management in most cases whether the household was male or female-headed. Family size did not also affect the household herd size for probably the same reason. The average family size of about six in Chinyuni ward was consistent with the district average of Chirumanzu (CSO, 2004) and with the national average (FAO, 2000; CSO, 2004).

The average age of the household heads revealed a population which is aging as in most rural communities. This was also revealed by Mashatise *et al.* (2005) who reported a similar average age of household heads in the rural district of Mutoko. Although aged farmers are well versed with traditional farming systems and rearing of local pigs, they do not easily agree with the introduction of new technologies (Scoones, 1992). However, the age of household head did not affect the size of the household herd. Aged communities develop due to rural to urban migration of the young and result in high labour shortages. Pressure on the countryside from the rapidly growing population and low returns from agriculture have contributed to an increase in rural-to-urban migration, especially for males. While such migration can increase remittances to rural areas and strengthen market linkages between urban and rural areas, it leaves rural women increasingly responsible for farming and for meeting their households' immediate needs (FAO, 1995).

**Table 3.5: Descriptive statistics of pig production parameters**

| Production parameter              | Minimum | Maximum | Mean | sd   | n  |
|-----------------------------------|---------|---------|------|------|----|
| Litter index                      | 1       | 2       | 1.5  | 0.50 | 56 |
| Litter size of recent farrowing   | 4       | 12      | 7.7  | 1.83 | 79 |
| Age at puberty of female (months) | 5       | 12      | 8.2  | 2.02 | 56 |
| Age at puberty of males (months)  | 6       | 12      | 8.9  | 2.16 | 56 |
| Parity number of sows at culling  | 1       | 4       | 2.0  | 1.52 | 56 |
| Age at culling of sows (years)    | 1       | 4       | 2.0  | 0.80 | 59 |
| Age at culling of boars (years)   | 1       | 3       | 1.4  | 0.56 | 59 |

sd-Standard deviation

n-number of households

Average arable land sizes in Chinyuni ward of Chirumanzu is consistent with most smallholder farms in Zimbabwe (Scoones, 1992) as most farmers were allocated about five hectares of land in the 1980s resettlement programs by the government of Zimbabwe. However not all of the land allocated is arable thus the average of 2.54 ha was the household average arable land. According to Scoones and Wolmer (2001), livestock and crop productivity Average arable land sizes in Chinyuni ward of Chirumanzu is consistent with most have a complementary role. This was found to be true with smallholder farmers in Chinyuni. Though most farmers kept pigs for family consumption as meat, more households reported that they reared pigs for manure production than for cash, this shows the relationship of crop and animal production in smallholder farming areas. Some households reported that they used local pigs for socio-cultural functions such as *nhimbe*. Pigs will be part of the meal given to community members that aid the host in weeding, harvesting and other farming activities that require labour. The community in Chinyuni however revealed it was taboo to use pigs as bridal price or appeasement of the spirits.

All the farmers interviewed kept at least two livestock species. A large diversity of animals reared in the study area might be a coping strategy by the community to spread the risk as suggested by Mashatise *et al.* (2005). Livestock are used as buffers against adversity or as savings and the size and value of stock will determine which to sell. Small stock would be sold when little cash is required and larger stock when the bill to be settled is big. It is therefore important for a household to have all sizes of stock. Bayer *et al.* (2003) state that it is an advantage for a smallholder family to keep different sizes of animals for different purposes. One or two chickens, a goose or turkey is enough for a normal family meal, a local pig, sheep or goat for a larger gathering while an ox is suitable for special occasions such as weddings or funerals to prevent wastage as refrigeration is usually unavailable (Bayer *et al.*, 2003).

The local pigs in the study area were owned women and pig production generally managed by women in terms of feeding and construction of housing. According to a report by FAO (1995) this was expected as women play a critical role in subsistence agricultural production including livestock keeping and food processing. Pigs are

generally considered as small stock and therefore owned and managed by women like other small stock that includes poultry and goats (FAO, 2005). Women normally get their livestock as gift from neighbors, friends and relatives. Local pig production can reduce vulnerability and dependence on food aid by women and children. The identification, improvement and promotion of livestock species that require little labour like local pigs can lessen the workload of HIV/AIDS affected and afflicted households and mitigate the adverse effects of HIV/AIDS on livestock production. This is because labour is usually limiting in such cases and this translates to reduced production in times when households need money for medication and health cost in general. This can also be a good intervention in most smallholder farming areas faced by labour shortages especially in aging societies.

Most households in the study area rear local pig genotypes. This is expected due to their suitability to production systems in smallholder farming areas (Anderson 2003; Mashatise *et al.*, 2005). Local pigs are adapted to the harsh tropical environment in that they can tolerate heat stress, disease challenge and poor nutrition, therefore they can survive and breed in adverse nutritional and climatic conditions (Holness, 1991; Zanga *et al.*, 2003). Livestock of different characteristics and hence outputs suit differing local community needs. The local pigs in Chirumanzu are not known as the Mukota but referred to as *Hochi* ( local term for pig) this is in agreement with Mashatise *et al.* (2005) who reported various names given to local pigs depending on study area.

Most of the farmers selected their breeding animals and, as expected, more households selected breeding males than they selected breeding females. Males are culled at an earlier age than females and more males than females are culled making selection more pronounced in males than females. The farmers had their own selection methods and criteria mostly reliant on memory. The farmers selected for pigs with short snouts, linear type traits and many other traits as defined by their breeding goals. They claimed pigs with long snouts are greedy and thus selected against them. Smallholder farmers have rational, non-commercial objectives that are reflected in their animal breeding practices (Bayer *et al.*, 2003).

The smallholder farmers' breeding practices limited inbreeding within their herd, but it could not be ascertained whether this was by design or not. This is because almost 75 percent of the farmers in the study area obtained breeding animals outside their household herd. Breeding boars were almost always sourced from outside the household herd. Most farmers did not keep boars. As the pigs were free ranging for most of the day, random mating was common. The majority of smallholder farmers in the study area selected their breeding stock and some would bring in pigs from outside their village for breeding purposes. Inbreeding, however, appeared to be a major constraint as most farmers reported a reduction in body size of their pigs over the years since they started rearing them or their early association with them. Since the local pig population in Chinyuni ward is small inbreeding is likely to be high. In addition, a small number of boars in the community coupled with uncontrolled breeding increases the chance of mating between related animals.

The average number of pigs born per litter in the study area of 7.7 was similar to that reported by Holness *et al.*, (2005) and by Mhlanga *et al.* (1999) of 7.3 to 7.9. According to Mhlanga *et al.* (1999) and Holness *et al.* (2005) local pigs are early maturing with gilts showing signs of oestrus as early as three months of age. The average age of puberty in the area of study was higher than expected as males had an average age of puberty of 8.9 months and female 8.2 months. Mhlanga *et al.* (1999) reported that local pigs first farrowed at 6 to 12 months of age. Since this study used questionnaires to investigate the age at puberty it is possible that the smallholder farmers viewed age at first pregnancy as the age first puberty.

Sows in Chinyuni ward of Chirumanzu were culled at an average parity of two or at two years old, which is early and wasteful in terms of production as a herd with a young age structure will have a lower fertility and litter performance than a herd where sows are retained to higher parities (Friendship *et al.*, 1986). In commercial pig production the reasons and rate of removal are influenced by housing, genotype, management policies, disease, nutrition and market trends (Friendship *et al.*, 1986) but in the smallholder system of production as in the study area the ability to feed the household herd determines when to cull and remove sows. The smallholder production

system is wasteful as most sows are culled after the second parity yet live births per litter increase from parity 1 to 3, peak from parity 3 to 6 and normally declines after parity 6 (Friendship *et al.*, 1986).

### **3.6 Conclusion**

Pig production plays an important role in agricultural systems and livelihoods of smallholder farmers in Chinyuni ward of Chirumanzu as a source of meat, cash saving, in socio-cultural activities and as a component of the complex but integrated agricultural production systems. Pigs in the area are not only a result of natural selection but deliberate selection by locals. Pig production levels in smallholder farming is low but is rational as far as subsistence agriculture production is concerned. It is, however, important to characterize the pig breeds in Chirumanzu in order to determine whether the population of pigs in that area is similar to the pigs characterized by Holness (1991)



## CHAPTER 4

### 4 Phenotypic characterisation of local pig in a smallholder farming area of Chirumanzu, Zimbabwe

#### 4.1 Abstract

A study was conducted to phenotypically characterise local pigs using 39 mature pigs in Chirumanzu, Zimbabwe. Pig body measurements were taken using a tape measure and phenotypic characters recorded were taken by observation. Female pigs contributed 76.9 % of the pigs characterised due to the higher culling rate of boars compared to sows. The average length of fore quarters was  $38.4 \pm 2.19$  cm for boars and  $43.3 \pm 1.20$  cm for sows while average length of hind quarters was  $38.9 \pm 2.38$  cm boars and  $43.1 \pm 1.31$  cm for sows. Ratio of length of fore-quarters to hind-quarters was  $1.0 \pm 0.02$  for boars and  $1.0 \pm 0.01$  for sows. Body conformation of the pigs as viewed from their rear end was blocky 48.7%, oval 35.9 % and 15.4 % round. It was found that 46.2 % of the pigs had 8 teats, 94.9 % lop eared. Most of the pigs were black (56.4 %), brown (26.6 %) and 17.9 % black and brown. It was concluded that local pigs are smaller than exotics, usually black with some brown and brown and black, they are lop eared and are blocky.

#### 4.2 Introduction

The conservation of local breeds is a topical issue whenever the development of animal production systems for the poor and smallholder farmers is discussed (Hall, 1992). Indigenous livestock is well adapted to tropical conditions as it has a high degree of heat tolerance, is resistant to many diseases prevailing in the tropics and has the ability to survive long periods of feed and water shortage (Anderson, 2003). Mukota pigs are part of the local AnGR that are available to smallholder farmers in Zimbabwe.

Conservation and utilisation of local pig genetic resources needs accurate identification and classification of animals and genotypes. This enables breeders and livestock producers to take advantage of the strengths of different genotypes. Breed characterisation requires knowledge of the extent of genetic variation that can be

effectively measured within and between populations (Hetzel and Drinkwater, 1992). Breeds are distinguished by such aspects as coat colour (hair and skin colour in pigs), morphological properties such as ear size and shape and body conformation (Ellis *et al.*, 1997).

Livestock breeds in developing nations have been less thoroughly characterised (Notter, 1999). Breed characterisation of local pig breeds has also not been done though Holness (1991) partially characterized local pigs in Mukota area of Mutoko in northeast Zimbabwe. The term Mukota is generally used to refer to all local pig strains and breeds found in Zimbabwe. The objective of this research was to phenotypically characterise local pigs in the semi-arid area of Chirumanzu, Zimbabwe and compare these to the phenotypic characters of Mukota pigs.

### **4.3 Materials and methods**

#### **4.3.1 Study site**

A detailed description of the study area is covered in section 3.3.1.

#### **4.3.2 Selection of participants**

Six villages were selected randomly from the ten villages that participated in the survey. All mature pigs from 32 household herds were used for the study. Only those farmers with mature local pigs aged between 1 and 2 years old and willing to participate were considered in the study.

#### **4.3.3 Phenotypic characterisation of indigenous pigs**

Phenotypic features collected included sex, body shape (blocky, round or oval), ear shape (lop or prick eared), eye colour, skin colour, hair colour, number of teats, shape of tail, length of fore quarters (FQ), length of hind quarters (HQ), ear length (EL) and length of the tail (TL). A tape measure and direct observation were used as data collection mechanisms. For each pig the ratios of FQ:HQ and EL:TL were computed. Thirty nine pigs were characterised and their ages ranged from 1 to 2 years.

#### 4.3.4 Statistical analyses

The generalised linear model procedure of SAS (1996) was used to investigate the effect of sex on FQ, HQ, EL, TL and ratios of FQ: HQ and EL: TL. The following linear model was used:

$$Y_{ij} = \mu + S_i + E_{ij}$$

Where,

$Y_{ij}$  = response variable (FQ, HQ, FQ: HQ, EL, TL and EL: TL);

$\mu$  = overall mean common to all observations;

$S_i$  = effect of sex (male or female pig);

$E_{ij}$  = random residual error distributed as  $N(0, I\sigma^2_e)$ .

The PROC FREQ procedure of SAS (1996) was used to analyse categorical data. The categorical data subjected to the PROC FREQ analysis were sex, shape of tail, body and ear, colour of eye, hair and skin and number of teats. Descriptive statistics (means, variances, standard deviations) were used to describe the trends of phenotypic characteristics. Body conformation of pigs was described as round, blocky and oval as seen from the rear end of the pigs.

#### 4.4 Results and discussion

Female pigs contributed 76.9 percent of the 39 mature pigs characterised while male pigs contributed 23.1 percent. This was expected as male pigs in the area under study had a higher culling rate than female pigs. Male pigs and piglets had a 60.3 percent chance of being culled first in a study area that had 30.1 percent of the respondents reporting that they didn't cull pigs at all. This is in agreement with the findings by Holness (1991) who stated that smallholder pig producers have a higher number of females due to high boar culling rates.

Body conformation of the pigs was characterised as 48.7 percent blocky, oval 35.9 percent and 15.4 percent round. The diet exposed to pigs especially piglets is suspected to be responsible for the different shapes observed. Differences in body conformation may in part be due to changes in nutrient partitioning as a result of the altered relationship between IGF-1 and leptin (Corson *et al.*, 2002). Body shape before weaning is important as it can provide a useful indicator to predict future growth and development of pigs.

Most of the pigs (94.9 percent) were lop-eared with only 5.1 percent prick-eared (Figure 4.1). However, this was inconsistent with reports by Holness and Smith (1970) and Mashatise *et al.*, (2005) who state that most local pigs in Mutoko had prick-shaped ears. This difference can be attributed to the different locations of the two populations and the possibility that the pigs in Chirumanzu were crossbred with exotics. Henson (1992) states that the differences observed between populations may be significant if their environmental conditions differ. Kohler-Rollefson and McCorkle (2000) also stated that local community breeding practices such as simple selection of animals to mate, culling and slaughtering or selling of animals considered unfit for breeding stock creates breeds or strains bringing diversity. To characterise a breed it is essential to record the habitat, food supply, climatic conditions, seasonal extremes, and management practices as well as the historical origins of the breed if these are known along with phenotypic traits and production parameters.

Black eyes were more prevalent (87.2 percent) than brown eyes (12.8 percent). The length of hair of the local pigs characterised varied from short to long though there were no hairless pigs which contrasts with reports by Mhlanga *et al.* (1999). The coat colour of the characterised pigs was black (56.4 percent), brown (26.6 percent) and black with brown patches or brown with black patches (17.9 percent). This is consistent with earlier observations by Holness (1991) and Mhlanga *et al.* (1999) who reported that local pigs have many coat colour variations with black and brown being most common while white is infrequent.



**Figure 4.1 Local pig gilt in Chirumanzu, Zimbabwe. Note the lop-ears and appearance of tail which is partially curled**

Number of teats of local pigs ranged from 6 to 10. Most of the pigs characterised had 8 teats (46.2 percent) while 43.6 percent of the pigs had 6 teats and 10.3 percent had 10 teats. The number of teats and spacing for both sows and boars are heritable traits which are of importance in pig production. Piglet mortality is high if the number of born alive is greater than the number of teats. The ideal number of teats commercially is 16 teats, but this may represent only 5 percent of the gilt population, with around 25 percent having 14, so the commercial choice is 12 good teats.

There was no difference in length of fore quarters and hind quarters, length of tail, ear length, ratio of fore quarters to hind quarters and ratio of ear to tail of the pigs according to sex (Table 4.1). The ratio of fore quarters to hind quarters was found to be 1.0 for both male and female pigs, which means that the pigs had quarters equal in length which is different from the well developed fore quarters and relatively light hindquarters reported by Holness (1991) and Mhlanga *et al.* (1999). The reason for this could be the difference in populations as local pigs in Chirumanzu and those in Mutoko area (North East Zimbabwe) which were studied by Holness (1991) due to the effect of the different environment. This difference can also be a result of selection practiced by people in the study area as reported by Kohler-Rollefson and McCorkle (2000). Numerous functions and thus traits of livestock may be specific to particular areas as reported by Bayer and co-workers (2003).

#### **4.5 Conclusion**

Local pigs in Chinyuni ward of Chirumanzu are smaller than exotic pigs. They do not have fore-quarters that are heavier than their hind quarters. The pigs usually have black hairs while some have brown hairs with pigs with black and brown hairs being rare. Most of the pigs in the area were lop eared and their tails are straight but slightly curled.

**Table 4.1: Least square means ( $\pm$  standard errors) of pig body measurements and ratios**

| <b>Measurement</b>                   | <b>Male pigs</b> | <b>Female pigs</b> |
|--------------------------------------|------------------|--------------------|
| Length of fore quarters (cm)         | $38.4 \pm 2.19$  | $43.3 \pm 0.01$    |
| Length of hind quarters (cm)         | $38.9 \pm 2.40$  | $43.1 \pm 1.20$    |
| Fore quarters to hind quarters ratio | $1.0 \pm 0.02$   | $1.0 \pm 0.01$     |
| Length of ears (cm)                  | $12.9 \pm 0.80$  | $14.1 \pm 0.44$    |
| Length of tails (cm)                 | $17.0 \pm 0.72$  | $18.4 \pm 0.40$    |
| Ear to tail ratio                    | $0.8 \pm 0.03$   | $0.76 \pm 0.02$    |

## CHAPTER 5

### 5 Assessment of local pig production and herd dynamics in the smallholder farming area of Chirumanzu, Zimbabwe

#### 5.1 Abstract

A study was conducted to determine the herd dynamics and production of local pigs in the smallholder semi-arid farming area of Chirumanzu, Zimbabwe. Thirty-two household pig herds were monitored for a period of six months. For each household, pig production potential (PPP) and pig production efficiency (PPE) were calculated. Village had an effect on household herd size ( $P = 0.002$ ) while month ( $P = 0.21$ ) and involvement of farmer in irrigation scheme ( $P = 0.06$ ) didn't. Village had an effect on PPP ( $P = 0.01$ ) but had no effect on PPE ( $P = 0.24$ ). Month didn't affect both PPP ( $P = 0.26$ ) and PPE ( $P = 0.05$ ) while having access to irrigation facilities affected household PPP ( $P = 0.03$ ) but had no effect on PPE ( $P = 0.53$ ). Household PPE was however affected by the interaction of village and month ( $P = 0.04$ ). There are many factors that affect pig production potential but production efficiencies were generally the same irrespective of production environment.

#### 5.2 Introduction

The importance of domestic animals as assets and a means of improving livelihoods for the poor is getting increasing recognition worldwide (Anderson, 2003). It was estimated by EU/DFID/IUCN (2001) that 1.96 billion people in the world rely on livestock to supply part of, or all, their daily needs. In a summary paper Delgado *et al.* (1999) present evidence from Africa, Asia and Latin America showing that the poor and landless people derive a higher proportion of household income from local livestock sources than do those with greater wealth living in the same communities. Most smallholder farmers rear local AnGR like Mukota pigs.



Local pigs, unlike imported genotypes, are less reliant on external inputs and are, therefore, part of a sustainable agricultural system for resource-poor farmers. They are generally hardy, survive and reproduce on low planes of nutrition (Holness and Smith, 1973; Mashatise *et al.*, 2005). An improvement in pig productivity, especially in the rural sector, could improve the livelihood of the resource-poor rural farmers (Hall, 1998). Local pigs are therefore suitable for smallholder or rural production.

There is, however, little information on how pigs under the traditional system are raised, including household herd sizes and dynamics, production potential and production efficiencies. This is vital to design intervention strategies that lead to sustainable development and improve well being and livelihoods of the poor. The objective of the study was to determine the herd dynamics, pig production potential and efficiency of indigenous pigs in a semi-arid smallholder farming area of Zimbabwe

### **5.3 Materials and Methods**

#### **5.3.1 Study site**

A detailed description of the study area is covered in section 3.3.1.

#### **5.3.2 Selection of participants**

Seven villages were selected randomly from the ten villages that participated in the baseline survey. Thirty two household herds were assessed monthly from October 2005 to March 2006. Only those households which had a pig herd at the start of the study and willing to participate were selected.

#### **5.3.3 Determination of herd dynamics**

Herd dynamics were monitored with the help of the farmers by use of recording sheets that captured the changes that occurred to the household herd for a period of 6 months. Visits were made every 4 weeks to collect and verify the records. The data collected per household included herd size and herd structure, number of piglets born, number and type of pigs slaughtered, number and type of pigs sold, number and type of pigs

borrowed, number and type of pigs bought-in and mortalities. The reasons for exits from the household herd and entries into the herd were recorded on the household record sheets.

The age of the pigs were categorised into piglets, growers and mature pigs. All suckling pigs were classified as piglets, reproductively active pigs (after puberty) were classified as mature pigs and all pigs weaned to puberty classified as growing pigs. Pigs were also categorised into sows, boars, gilts, immature boar and piglets. Exchanges, gifts and entrusted pigs were recorded as either entries or exits, depending on whether the pigs were entering or leaving the household herd.

For each household, pig production potentials (PPP) and pig production efficiencies (PPE) were calculated. The PPP was defined as the proportion of mature and growing pigs to the total herd size as shown below:

$$PPP = \frac{N}{H}$$

Where;

PPP = production potential;

N = number of mature pigs + growing pigs (excluding suckling piglets); and

H = herd size.

The PPE was calculated as the proportion of pigs sold and/or consumed as a fraction of the PPP.

$$PPE = \left( \frac{M}{PPP} \right) \times 100$$

Where;

PPE = pig production efficiency;

M = number of mature pigs consumed or sold; and

PPP = pig production potential.

#### 5.4 Statistical analyses

The influence of month, village, and access to irrigation on herd size, pig production potential and pig production efficiency were determined using PROC GLM procedure of SAS (1996). PPP and PPE were not normally distributed and were therefore ArcSin transformed. The linear model used was:

$$Y_{ijkl} = \mu + R_i + M_j + V_k + (R \times M)_{ij} + (R \times V)_{ik} + (V \times M)_{jk} + (R \times M \times V)_{ijk} + E_{ijkl},$$

where;

$Y_{ijkl}$  = response variable being herd size, ArcSin PPP, ArcSin PPE;

$\mu$  = overall mean common to all observations;

$R_i$  = effect of access to irrigation ( $i$  = irrigation, dry land);

$M_j$  = effect of month ( $j$  = October, ..., March);

$V_k$  = effect of village (Mazarire, Manhayi, Vengayi, Mada, Vurayayi, Machechera, Mberikwazvo);

$(R \times M)_{ij}$  = access to irrigation x month interaction;

$(R \times V)_{ik}$  = access to irrigation x village interaction;

$(V \times M)_{jk}$  = village x month interaction;

$(R \times M \times V)_{ijk}$  = interaction of access to irrigation, village and month; and

$E_{ijkl}$  = random residual error distributed as  $N(0, I\sigma^2_E)$ .

All the interactions had no effect on PPP, PPE and herd size except the village by month interaction. These interactions were excluded from PROC GLM analyses and the model used was as follows;

$$Y_{ijkl} = \mu + R_i + M_j + V_k + (V \times M)_{jk} + E_{ijkl}$$

## **5.5 Results**

### **5.5.1 Herd size**

Village had an effect on household herd size ( $P = 0.002$ ), the least square means for household herd size per village is shown in Table 5.1. The involvement of farmers in irrigation schemes in Chinyuni ward didn't have an effect on household herd size as there was no difference in herd size between those farmers that irrigated and those that didn't ( $P = 0.07$ ). Month had no effect on household herd size ( $P = 0.21$ ). The interaction of village and access to irrigation, village and month or month and access to irrigation did not affect the household herd size.

### **5.5.2 Pig production potential**

Village had an effect on the pig production potential (PPP) ( $P = 0.01$ ). The smallholder farmers that irrigated their crops or those in the irrigation schemes had higher PPP than those who didn't irrigate ( $P = 0.03$ ). Month had no effect on PPP ( $P = 0.26$ ). The interaction of village and access to irrigation, village and month or month and access to irrigation did not affect the household PPP.

### **5.5.3 Pig production efficiency**

The interaction of village and month had an effect on the pig production efficiency ( $P = 0.043$ ) with a general decline in PPE with month in all villages. There was no effect of village ( $P = 0.239$ ) month ( $P = 0.065$ ) irrigation ( $P = 0.532$ ) on PPE.

## **5.6 Discussion**

Herd size did not change with month and access to irrigation though access to irrigation showed marginal effect which is indicative of some effect. This was not expected. The effect of access to irrigation could have been more pronounced if a greater number of pig herds were monitored or if the study period was longer giving more records. The monitoring period of 6 months was not long enough to capture effects of changes in month on the herd size. For example the effects of a rainy month can manifest after a

**Table 5.1 Least square means ( $\pm$  standard errors) of herd sizes, ArcSin pig production potential and ArcSin pig production efficiency of the seven villages**

| Village     | Herd size                    | ArcSin PPP                   | ArcSin PPE                       |
|-------------|------------------------------|------------------------------|----------------------------------|
| Machekera   | 2.2 <sup>a</sup> $\pm$ 0.88  | 1.4 <sup>a</sup> $\pm$ 0.18  | 0.0052 <sup>a</sup> $\pm$ 0.0026 |
| Mada        | 1.2 <sup>a</sup> $\pm$ 0.97  | 1.7 <sup>a</sup> $\pm$ 0.21  | 0.0027 <sup>a</sup> $\pm$ 0.0029 |
| Manhayi     | 6.5 <sup>b</sup> $\pm$ 0.72  | 0.5 <sup>bc</sup> $\pm$ 0.16 | 0.0013 <sup>a</sup> $\pm$ 0.0021 |
| Vengayi     | 4.1 <sup>ab</sup> $\pm$ 0.93 | 0.6 <sup>bc</sup> $\pm$ 0.21 | 0.0018 <sup>a</sup> $\pm$ 0.0029 |
| Mazarire    | 1.5 <sup>a</sup> $\pm$ 0.97  | 0.3 <sup>bc</sup> $\pm$ 0.21 | 0.0001 <sup>a</sup> $\pm$ 0.0030 |
| Vurayayi    | 4.9 <sup>a</sup> $\pm$ 0.97  | 1.3 <sup>a</sup> $\pm$ 0.21  | 0.0018 <sup>a</sup> $\pm$ 0.0029 |
| Mberikwazvo | 1.6 <sup>a</sup> $\pm$ 0.97  | 1.4 <sup>a</sup> $\pm$ 0.22  | 0.0084 <sup>a</sup> $\pm$ 0.0030 |

<sup>abc</sup> Values within a column, with different superscripts differ ( $P < 0.05$ )

few weeks when feed becomes available while those of flooding can be immediate. The period of study was in the dry hot season and hot and wet season. The herd size observed could therefore have been a manifestation of the effect the cold and dry season and dry hot season.

The PPP was low in the study area as the proportion of piglets to mature or growing pigs is generally high. Since PPP is affected by age at culling and parity of culling of pigs it is low as many farmers cull their sows and boars early before high reproductive performance is realised. Sows are expected to have their highest reproductive performance from parity 3 to 6 (Friendship *et al.*, 1986). Most households keep less than 4 mature or growing pigs as they cull older pigs in times of feed shortages due to their higher feed requirements compared to piglets. The culling rate in the study area was very high resulting in a herd with young pigs and an increased proportion of gilts in the breeding herd, thus a lower than optimum litter size (Friendship *et al.*, 1986).

Monitoring entries and exits over time, is a good indicator of herd productivity and contributions of pigs to livelihoods of smallholder farmers. The production efficiency that was observed in the study was not comparable to the production potential obtained. The PPE monitors the mature pigs sold or slaughtered but neglects the sale of piglets. It also fails to capture other production outputs of smallholder pig production like manure production and the value of pig gifts-out that were noted by Mashatise *et al.* (2005), Holness *et al.* (2005) and in the first experiment of this study. It is therefore important to come up with a PPP and PPE formulae that considers the all production outputs and contribution of local pigs to the livelihoods and social status of rural farmers.

## **5.7 Conclusion**

It was concluded that the PPP was generally low because of the high culling rates in the area under study. The PPE was, however, low but constant over a range of environments and conditions including month, access to irrigation and village. Herd size did not change by month.

## CHAPTER 6

### 6 GENERAL DISCUSSION

Local pigs dominated pig production in Chinyuni ward of Chirumanzu. The pigs were however not known as Mukota as reported by Holness (1991) and Mashatise *et al.* (2005) but known as *Nguruve* or *Hochi*, local names that simply mean pig. Although pig productivity in the study area was generally low in terms of meat consumed or sold as represented by low PPE it contributed to the livelihoods of smallholder farmers. This was through capture of common property rights and their transfer for private benefit for example grazing in communal lands and then providing manure for use in crop fields. Local pigs are suitable for such complex production systems. Drucker and Anderson (2004) state that animals of different genetic, productive and adaptive characteristics suit differing local community needs.

Low utilisation of rare AnGR does not imply low value (Gollin and Evenson, 2003). The PPE value in the study area is low as it relates to slaughter and sale of pigs but this does not mean that local pigs have no value. The indirect use value (an option value) of preserving these pigs is high enough to outweigh the cost of preserving them due to the many roles they fulfil to household livelihoods. In addition, herd sizes were affected by high mortalities in the area due to poor housing, low hygiene and unavailability of feed which affects the PPE. Improvement of these management factors may increase PPE.

The household herd size was small and consisted mostly of sows, gilts and piglets. Most households had less than three sows in their herd and a relatively high number of piglets and this is shown by low PPP. This is related to the culling practices of the farmers as they tried to curb the adverse effects of feed shortages. Boars were culled first in times of feed shortages, which is most of the year in smallholder farming areas, while sows were culled last.

The local pigs found in the study area had some phenotypic characters that differed from those found in other areas of Zimbabwe. Kohler-Rollefson and McCorkle (2000), state that virtually every long-time stock raising society develops breeds to suit its particular

environment and animal-product needs and wants. The differences in the shape of tail and body conformation of local pigs observed in Chinyuni ward to what was earlier observed by Holness (1991) and Mashatise *et al.*, (2005) in Mutoko could be a result of slight differences in breeding goals. The differences in breeding goal can result in development of new pig breeds and strains. The local pig population in Chirumanzu and mutoko can possibly be two breeds.

A central objective of the work was to provide a basis for future research oriented towards the establishment of an appropriate conservation breeding programmes for local pig breeds. The reaserch provides information for macro stage and part of the information of the meta stage of breed description. These are the first and second stages of three breed description technique as described by Matheron and Planchenault (1992) and Lebbie and Kamau (2001).A need still remains to fully describe the genome of local pigs in Zimbabwe to complete the description of local pig breeds.



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## 8 APPENDICES

### Appendix 1: Questionnaire used in survey of local pig genetic resources

**A survey of local pig genetic resources, breeding systems and contribution of local pigs to the livelihoods of smallholder farmers in a semi-arid farming area of Chirumanzu, Zimbabwe**

Village Name: \_\_\_\_\_ Questionnaire No. \_\_\_\_\_

Enumerator: \_\_\_\_\_

#### Household demographics

|    |                                   |                         |      |                                                                                         |
|----|-----------------------------------|-------------------------|------|-----------------------------------------------------------------------------------------|
| 1. | Age of household head.            |                         |      |                                                                                         |
| 2. | Sex of household head             |                         |      | 1 = male      2 = female                                                                |
| 3. | Marital status of household head  |                         |      | Married .....1<br>Widowed .....2<br>Separated .....3<br>Divorced .....4<br>Single.....5 |
| 4. | Total number of household members |                         |      |                                                                                         |
| 5. | How many are                      | Age range               | Male | Female                                                                                  |
|    |                                   | Below 12                |      |                                                                                         |
|    |                                   | Between 13 and 64 years |      |                                                                                         |
|    |                                   | Above 65 years          |      |                                                                                         |

#### Socio-economic situation of farmers

|    |                                  |                |                 |                     |
|----|----------------------------------|----------------|-----------------|---------------------|
| 6. | Land size (acres)                | Dry land/acres | Irrigated/acres |                     |
|    |                                  |                |                 |                     |
| 7. | Do you have access to irrigation | Yes            | No              |                     |
| 8. | Sources of income                | Source         | Rank            | Sold 2004/05 season |
|    |                                  | Pigs           |                 |                     |
|    |                                  | Cattle         |                 |                     |
|    |                                  | Goats          |                 |                     |
|    |                                  | Sheep          |                 |                     |
|    |                                  | Poultry        |                 |                     |
|    |                                  | Donkeys        |                 |                     |
|    |                                  | Field crops    |                 |                     |
|    |                                  | Garden crops   |                 |                     |

|     |                                                              |                     |                                   |  |
|-----|--------------------------------------------------------------|---------------------|-----------------------------------|--|
|     |                                                              | Others<br>(specify) |                                   |  |
| 10. | Livestock species owned by the household                     | Livestock species   | Number                            |  |
|     |                                                              | Cattle              |                                   |  |
|     |                                                              | Pigs                |                                   |  |
|     |                                                              | Goats               |                                   |  |
|     |                                                              | Poultry             |                                   |  |
|     |                                                              | Sheep               |                                   |  |
|     |                                                              | Donkey              |                                   |  |
|     |                                                              | Others (specify)    |                                   |  |
| 11. | Who owns the pigs in the household herd                      |                     |                                   |  |
|     | Owner                                                        |                     | Number                            |  |
|     | Father                                                       |                     |                                   |  |
|     | Mother                                                       |                     |                                   |  |
|     | Boy child                                                    |                     |                                   |  |
|     | Girl child                                                   |                     |                                   |  |
|     | Other (specify)                                              |                     |                                   |  |
| 12. | a. Do you keep records?                                      | Yes                 | No                                |  |
|     | b. If yes. Who keeps the records?                            |                     |                                   |  |
|     | c. What type of records?                                     |                     |                                   |  |
|     | d. How do you use these records?                             |                     |                                   |  |
| 13. | Who does the following duties for the household pig herd     |                     | Gender (e.g. son, father, mother) |  |
|     | General management                                           |                     |                                   |  |
|     | Construction of housing                                      |                     |                                   |  |
|     | Attending developmental meetings                             |                     |                                   |  |
|     | Others duties (specify)                                      |                     |                                   |  |
| 14. | Do you keep pigs for the following reasons (tick applicable) |                     |                                   |  |
|     | Sales                                                        |                     |                                   |  |
|     | Own consumption                                              |                     |                                   |  |
|     | Cultural and social roles                                    |                     |                                   |  |
|     | Manure production                                            |                     |                                   |  |
|     | Others (specify)                                             |                     |                                   |  |

**Pig breeding management**

|     |                                                      |                         |                    |
|-----|------------------------------------------------------|-------------------------|--------------------|
| 15. | Source of pigs (Tick where applicable)               | Household               |                    |
|     |                                                      | Village                 |                    |
|     |                                                      | Outside the village     |                    |
|     |                                                      | Other (specify)         |                    |
| 16. | What type of pig breeds do you keep                  | Local                   | Exotic Crossbreeds |
| 17. | What name do you give to the breed of pigs you keep? | .....<br>.....<br>..... |                    |



|          |                                                                                                     |                          |            |            |
|----------|-----------------------------------------------------------------------------------------------------|--------------------------|------------|------------|
| 18.      | a. Do you select breeding sows?                                                                     |                          | Yes        | No         |
|          | b. If yes. What traits do you consider?<br>(tick where applicable)                                  | 1. Litter size           |            |            |
|          |                                                                                                     | 2. Linear type traits    |            |            |
|          |                                                                                                     | 3. Mothering ability     |            |            |
|          |                                                                                                     | 4. Litter index          |            |            |
|          |                                                                                                     | 5. Other                 |            |            |
| 19.      | Do you select boars? (tick where applicable)                                                        | 1. Body size             |            |            |
|          |                                                                                                     | 2. Body conformation     |            |            |
|          |                                                                                                     | 3. Other (specify)       |            |            |
| 20.      | a. Do you cull your pigs?                                                                           |                          |            |            |
|          | b. If yes. Age and parity for sows?                                                                 |                          | Parity     | Age        |
|          | c. At what age for boars?                                                                           |                          |            |            |
|          | Reasons for culling?                                                                                | Lack of feed             |            |            |
|          |                                                                                                     | Injuries and deformities |            |            |
|          |                                                                                                     | Poor fertility           |            |            |
| Diseases |                                                                                                     |                          |            |            |
|          |                                                                                                     | Other (specify)          |            |            |
| 21.      | Order of culling in feed deficits                                                                   |                          |            | Age        |
|          | 1                                                                                                   |                          |            |            |
|          | 2                                                                                                   |                          |            |            |
|          | 3                                                                                                   |                          |            |            |
|          | 4                                                                                                   |                          |            |            |
|          | 5                                                                                                   |                          |            |            |
|          | 6                                                                                                   |                          |            |            |
| 22.      | a. Do you acquire animals for breeding purposes (buy in, borrow or otherwise)?                      |                          | Yes        | No         |
|          | b. Where from?<br>1.....<br>.....<br>2.....<br>.....<br>3.....<br>.....<br>4.....<br>.....<br>..... |                          |            |            |
| 23.      | Is breeding seasonal?                                                                               |                          | Yes        | No         |
| 24.      | a. If yes, which months of the year do you breed your pigs?                                         |                          | Dry season | Wet season |

|     |                                                                                              |            |    |            |
|-----|----------------------------------------------------------------------------------------------|------------|----|------------|
|     | b. Why do you breed your pigs in the stated months?.....<br>.....<br>.....<br>.....<br>..... |            |    |            |
| 25  | Which times of the year do your pigs have the highest number of piglets furrowed?            | Dry season |    | Wet season |
| 26. | Number of farrowings /sow / year                                                             |            |    |            |
| 27  | Age of puberty                                                                               | Sows       |    | Boars      |
| 28. | Litter size of most recent farrowing                                                         |            |    |            |
| 29. | Constraints to breeding management                                                           |            |    |            |
|     | Shortage of boars                                                                            |            |    |            |
|     | Communal or random mating                                                                    |            |    |            |
|     | Small body size                                                                              |            |    |            |
|     | Other (specify)                                                                              |            |    |            |
| 30. | Is inbreeding a problem?                                                                     | Yes        | No |            |

## Appendix 2: Data sheet used for monitoring herd dynamics

Monthly Pig Herd Sizes in Chinyuni Ward, Chirumanzu

Household Name: \_\_\_\_\_ Village: \_\_\_\_\_

Date: \_\_\_\_\_

|                | No. at the beginning of the month | No. at the end of the month |
|----------------|-----------------------------------|-----------------------------|
| Boars          |                                   |                             |
| Sows           |                                   |                             |
| Unserved gilts |                                   |                             |
| Immature       |                                   |                             |
| Piglets        |                                   |                             |

|                | No. Purchased | Amount (\$) | No. sold    | Amount (\$) | Reason for sales     |
|----------------|---------------|-------------|-------------|-------------|----------------------|
| Boars          |               |             |             |             |                      |
| Sows           |               |             |             |             |                      |
| Unserved gilts |               |             |             |             |                      |
| Immature boars |               |             |             |             |                      |
| Piglets        |               |             |             |             |                      |
|                | Gift-in       | Gift-out    | Slaughtered | Deaths      | Reason for slaughter |
| Boars          |               |             |             |             |                      |
| Sows           |               |             |             |             |                      |
| Unserved gilts |               |             |             |             |                      |
| Immature boars |               |             |             |             |                      |
| Piglets        |               |             |             |             |                      |

Farrowings

|                  |  |
|------------------|--|
| No. of litters   |  |
| No. born alive   |  |
| Piglet mortality |  |

Remarks

.....  
.....  
.....  
.....

### Appendix 3: ANOVA tables for Statistical Analyses carried out

#### a) GLM analysis for the effect of village, month and access to irrigation on PPP (ArcSin transformed)

| Source        | DF | Type III SS | Mean Square | F Value | Pr > F |
|---------------|----|-------------|-------------|---------|--------|
| VILLAGE       | 6  | 7.86458835  | 1.31076472  | 2.92    | 0.0104 |
| IRRIGATE      | 1  | 2.20286902  | 2.20286902  | 4.91    | 0.0284 |
| MONTH         | 5  | 2.95040888  | 0.59008178  | 1.31    | 0.2616 |
| VILLAGE*MONTH | 30 | 8.39725426  | 0.27990848  | 0.62    | 0.9342 |

#### b) GLM analysis for the effect of village, month and access to irrigation on PPE (ArcSin transformed)

| Source        | DF | Type III SS | Mean Square | F Value | Pr > F |
|---------------|----|-------------|-------------|---------|--------|
| VILLAGE       | 6  | 0.00065912  | 0.00010985  | 1.35    | 0.2399 |
| IRRIGATE      | 1  | 0.00003195  | 0.00003195  | 0.39    | 0.5321 |
| MONTH         | 5  | 0.00086821  | 0.00017364  | 2.13    | 0.0654 |
| VILLAGE*MONTH | 30 | 0.00384319  | 0.00012811  | 1.57    | 0.0434 |

#### d) GLM analysis for the effect of village, month and access to irrigation on herd size

| Source        | DF | Type III SS | Mean Square | F Value | Pr > F |
|---------------|----|-------------|-------------|---------|--------|
| VILLAGE       | 6  | 211.647619  | 35.274603   | 3.63    | 0.0022 |
| IRRIGATE      | 1  | 33.347222   | 33.347222   | 3.43    | 0.0659 |
| MONTH         | 5  | 70.006113   | 14.001223   | 1.44    | 0.2127 |
| VILLAGE*MONTH | 30 | 220.178571  | 7.339286    | 0.76    | 0.8142 |