

Full Length Research Paper

Inventory of pig production systems in Rwanda

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Pig production systems in Rwanda are not well understood to enable effective exploitation of their potential for rural poverty alleviation and human nutrition. A study was therefore conducted to characterize the current status of pig production systems in Rwanda. Questionnaires were administered to 179 semi-intensive and intensive pig farmers randomly selected at sector level. Data were processed in statistical package for social sciences (SPSS) version 16. Most pig houses were semi-permanent (64.8%). Farm records were rarely (38%) kept. Reproduction was only by natural mating. European pig breeds and their crosses predominated. Farmers purchased feedstuffs for mixing at farm level with maize bran as the main basal feedstuff (64.4%). Disinfectants were rarely (23%) used in cleaning sties. The most disease condition commonly reported were piglet scours (25.3%), piglet anaemia (20.9%), swine respiratory disorders (18.8%), skin disorders (18.5%) and worm infestations (16.5%). Pigs were sold at all stages of maturity. Litter size averaged 7.2 ± 2.2 and pre-weaning mortality was 12.5%. Most farmers (66.8%) reported lack of affordable quality feeds followed by lack of breeding stock (43.5%), disease control (38.2%), marketing (37.4%) and availability of credit (26.9%) to be the main challenges. Predictive modelling shows that by use of small technologies and improved management interventions net profit/sow could be greatly increased by 203%.

Key words: Semi-intensive, characterization, swine production.

INTRODUCTION

In Rwanda, livestock production is a major agricultural activity contributing about 8.8% of the National GDP (Food and Agricultural Organization (FAO), 2011). Most of the land surface area in Rwanda is hilly and rocky, thereby minimizing availability of land for agriculture. Poultry and pig rearing has to be emphasized in order for Rwanda to efficiently use the available land sustainably and quicken the attainment of satisfactory levels of food security and poverty alleviation.

Pigs like poultry have high turnover rate, quick return on investment, high growth rate and a short generation interval. They do not contribute to loss of grazing land as they can be raised for their entire life time in enclosures, and pigs have high feed conversion ratio (Mpfungu et al., 2011). The contribution of pig meat to protein nutrition for the world population is very high. Pigs require minimal inputs in terms of family labour and feeding, perhaps an important motivation for farmers to raise pigs (Whittemore,

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1996). Pigs require less space compared to other livestock species and could be raised by anybody, including children. Additionally, pigs have relatively low cost of production and they adapt easily to environmental conditions (ILCA, 1992). Following the 1994 genocide in Rwanda, there has been many policies and strategies in the agriculture sector geared towards intensification and commercialization of pig and poultry production systems (Vision 2020 EDPRS 2). Many systems that were previously predominantly tradition and subsistence are currently at various levels of transition/evolution to modern semi-intensive or intensive production systems. In order to improve production, the characteristics of the existing systems must be known and well documented.

METHODOLOGY

The study was designed to assess the current status of the intensive and semi-intensive pig production systems in the various agro-ecological zones of Rwanda. Pre-tested questionnaires were administered to pig farmers by trained enumerators. A total number of 179 pig farmers were chosen by multi-stage sampling at district and sector level, then randomly within the selected cells. Most of the respondents were from Eastern province (25%) followed by Northern (22.9%), Western (19.5%), Southern provinces (16.2%) and Kigali city (15.6%). Data were processed in statistical package for social sciences (SPSS) and presented in texts, tables and charts. Case studies were conducted on selected representative farms to validate the survey results.

RESULTS AND DISCUSSION

Location of the respondents

Most of the respondents were from Eastern province (25%) followed by Northern (22.9%), Western (19.5%), Southern provinces (16.2%) and Kigali city (15.6%). The distribution of respondents was that the majority were from peri-urban areas (41.9%), whereas 29.5 and 29.6% were from urban and rural areas, respectively. With regard to accessibility, the majority of respondents were from within 5 km (61%) from the main road and only 9.8% of the respondents were more than 15 km from the main road.

Gender, age and education level of the respondents

The majority of the respondents were males (79.2%) and they used employees (45%), followed by husbands (36.5%), children (9.6%), and spouses (8.9%) to look after the pigs. Most of the respondents (51.7%) had attained primary level of education. This low level of education among the respondents could be attributed to low wages on pig farms and also to the fact that the majority of Rwandese (78.6%) has primary level of education (National Institute of Statistics of Rwanda (NISR), 2012). The age of respondents ranged between

Table 1. Sex disaggregation of the daily pig rearing activities.

Activity	% Male	% Female
Feeding	93.7	6.3
Cleaning	82.4	17.6
Treating	95.1	4.9
Selling	83.7	16.3
Purchasing	83.4	16.6
Record keeping	83.5	16.5

18 and 57 years, with a mode range of 34 to 41 years (27.7%).

Labour and gender involvement

Permanent hired labour was reported (65%) to be the main form of labour followed by family labour (20%) and hired casual labour (15%). Males were mainly reported (85%) to be farm managers and most of them (54%) had attained primary level of education and small proportion of them (30%) had attended some training on pig production. It is noteworthy that males were the main actors in most farm activities (Table 1). These results are different from the situation reported in Central Kenya (FAO, 2012) where women play a major role in the semi intensive system. They feed the pigs and are responsible for gathering and applying farmyard manure. Men sell the pigs and control the way the money is used. The pig traders approach the men rather than the women who have no say in pig sales. In most cases the men buy replacement pregnant gilts, weaner or a young boar in the expectation that the women continue to raise whatever livestock is around.

General farm management (breeding, housing, feeding)

Animal identification

Modern pig identification techniques use were still at a low level as only 38% of the farmers reported using ear tags (71.6%) and 10.4% use branding while 7.5% were just naming the pigs according to colours, sex and age.

Record keeping

Record keeping was found to be gaining ground as most farmers (72.6%) reported keeping at least one type of record. The records on income and expenditure, feeding, production and reproduction were the most kept records whereas only 28% of farmers kept health records. Record keeping increased the education level of the managers

Table 2. Rate (%) of record keeping as affected by education level.

Education level	Record keeping
No formal education	20 64.5%
Primary education	65 69.1%
Secondary education	27 79.4%
Tertiary education	15 93.8%
Total	127 72.6%

(Table 2). This indicates that farmer/manager training is likely to increase the efficiency of farm operations. On most of the farms, farm managers and hired workers (66.9%) were responsible for record keeping and books (82.7%) were mainly used. Digital record keeping was still very low as it was reported by only 2.4% of respondents. Other methods of record keeping included writing on walls (3.1%), blackboard (1.6%), and human memory (7.1%).

Breeding

The Landrace breed of pig was the main breed (37.7%) kept followed by none descript crosses (28.1%), large white (22.9%), Pietrain (7.3%) and Duroc (1.6%). Only 2.3% of the respondents kept the local breed. These results differ from those reported in Kenya, where the Large White is the main breed utilized due to its desirable growth potential and high fecundity (Ilatsia et al., 2008). In Wakiso district in Uganda, the most dominant pig breed type was cross breeds of Local Ugandan breeds with Landrace and large white (67.4%) followed by pure exotic Landrace (28.1%) and Large White (4.4%) (Muhanguzi et al., 2012). The results of this study also showed that all breeds are not specific for any Rwandan region; which is different from the case of Vietnam where in hillsides far from town they encountered the Vietnamese local breed called Ban, and in mountain valleys near the town, the Vietnamese improved breed, Mongcai and its crossbreeds were dominating (Lemke et al., 2002).

There was no organized swine breeding as farmers reported that they were obtaining their farm stock from either their neighbours or commercial farms and local market. The choice of the stock was reported to depend

mainly on the advice of peer farmers (65.4%) or securing the only available breed in their vicinity (34.1%) and just accessing donations and gifts (0.5%). This is almost similar to the situation reported in Wakiso district of Uganda where the majority (55%) of the farmers got their breeding stock from other farmers. Two percent of the farmers got their replacement stock from their own parent stock while 43% got their replacement stock in form of gifts (Muhanguzi et al., 2012). In Kenya, breeding stock was reported to be sourced from government institutions such as the Agricultural Development Corporation (ADC) and Kenya Agricultural Research Institute (KARI), or from Farmer's Choice Limited, or from neighbouring commercial farms. Farmer's Choice Limited sells some good breeding stock to their contract farmers so as to enable them to supply finished pigs to their factory. These contract farmers sell the breeding stock to other commercial farmers (FAO, 2012). Only 31.8% of the respondents reported awareness of artificial insemination in swine breeding and its advantages and 81% of these reported willingness to use the service if it was available. Hand mating was reported (66.5%) to be more popular than pen mating in natural breeding. This could be attributed to inadequate pens in the piggeries.

Pig housing

Housing structures were categorized as temporary, semi-permanent or permanent and the majority of the respondents had semi-permanent structures (64.8%), while 25.1% had permanent structures and only 10.1% of the respondents provided temporary shelters to the pigs on the farm. The results in Rwanda are different from those of Wakiso district of Uganda where 70.4% of farmers in semi-intensive and intensive system used permanent houses (Corrugated iron sheets, bricks and concrete) and 22.2% used semi-permanent houses (Muhanguzi et al., 2012). For farms that housed boars, the average floor space per boar was $3.5 \pm 0.8 \text{ m}^2$ (Table 3) which is below the recommended value but the floor space provided for other age groups and sexes were generally either in or above the range (FAO, 2009). In most cases (63.8%) the orientation of pig houses was correctly done in the east-west direction to ensure more shade time and air circulation. This is indicative of some level of progress towards intensification.

Another notable feature of quality in pig house construction was the provision of pits for waste disposal which were observed on 70.2% of the farms. The collected manure was reportedly used for fertilization of crop field.

Feeding

A high proposition of pigs farmers (65.9%) were buying commercial feedstuff for supplementary feeding and at

Table 3. Floor space allowance for different age groups on pig farms as compared to standard.

Parameter	Min	Max	Mean	Std. Deviation	Recommended (FAO, 2009)
Density in farrowing pen	1	20	4.5	2.7	4 -6
Density in Gilt/sow pen	0.16	8.5	2.9	1.6	1.5 -2.5
Density in weaners/growers pen	0.12	8.5	2.7	1.8	0.5 -1
Density in boar house	1	8.5	3.4	1.7	6- 8

Table 4. Use of common feedstuffs for pig feeding.

Ingredients	Frequency	Percentage
Maize bran	112	64.4
Swill	105	60.3
Sweet potatoes	60	34.5
Non-conventional feed*	55	31.6
Rice bran	48	27.6
Brewers waste	48	27.6
Blood	44	25.3
Soybean meal	43	24.7
Cotton seed cake	39	22.4
Red soils	14	8.0

* Intestinal residues, wild vegetables, fruits.

Table 5. Quantity feed (gm)/day/ pig

Age category	Mean	Std. Deviation	Quantity recommended (FAO, 2009)
Piglet	1021.0	707.2	1000 -1500
Grower	1891	845.6	1500 – 2000
Gilt	2317.5	851.1	2000- 2500
Sow	2665.5	896.4	2500
Boar	2820.4	842.6	2500

times on-farm ration formulation; 30.2% of the farmers fed the pigs on home grown feedstuff while 58.6% fed swill (chicken remains) as a sole feed or a supplement to other feedstuffs. In Vietnam, all farmers in demand driven pig production system were reported to use concentrates from industries and the majority of them cultivate maize and cassava for pigs (Lemke et al., 2002). In Guadeloupe, agricultural residues consisting of the culls of export bananas, vegetable waste, fruit or sugar cane are used (Zebus et al., 2005). The proportion of the farmers that grazed their pigs was 43%, which is much better than in the purely traditional system where pigs are grazed for most of their time without any supplementary feeding. Farmers used different types of feedstuffs as basal feed or supplements and the choice on type and quantity depended on availability and price (Table 4).

However the majority tended to use maize bran and swill.

The quantity of feed given to pigs was found to be below or close to the FAO (2009) recommendations (Table 5) but the results from the case studies show that the quality remains low.

According to Muhanguzi et al. (2012) in Uganda the majority of farmers (59%) reported that they fed their pigs on cassava, potatoes and crop residues (sweet potato vines, banana peelings). 24% of all pig farmers fed their pigs grasses like *Pennisetum purpureum*, *Commelina banghalensis*, and *Biden pilosa* while 16% of the farmers fed their pigs on intestinal contents from the local abattoirs.

In Kenya, the main feedstuff reported were cottonseed cake and prairie meal, with gluten feed as a source of protein. Pigs were also reported to be in competition with

Table 6. Reproduction and production parameters.

Parameter	Mean	Std. Deviation
Average litter size (live-born) at farrowing	7.2	1.559
Average farrowings /sow/year	2.0	0.423
Duration from farrowing to weaning (Month)	2.41	0.789
Average number of piglets weaned /farrowing	6.5	1.915
Average weight of slaughter pigs (Kg)	78.08	27.820
Average age at slaughter (Months)	9.43	4.603
Average age at first breeding (Months)	11	1.643

humans for maize as their main source of energy. Other energy sources used include milled by-products such as the bran from wheat, maize and rice, along with maize grain, wheat grain and semi-refined oil. Limestone was the main source local mineral (FAO, 2012). Supplementation of piglets with iron was reported by 45% while 71% reported the use of multi-vitamins to supplement the piglet's diet. In villages of Masaka, Mukono and Kamuli districts in Uganda, only 9.5% of farmers were giving iron injection to their piglets (Ouma et al., 2014). It is also notable that 48% of the farmers were practicing creep feeding of piglets. Access to water was generally satisfactory as the majority of farmers (71.3%) had tap water, 18% used spring water, 7.8% used water from dams and lakes and 2.8% had water storage facilities to collect rain water.

Animal health management

A high level of farmer's access to veterinary services was reported in all in provinces and public veterinary services were most preferred (45.5%) followed by private veterinary services (37.1%) whereas 17.4% used either of the services depending on the availability. With regard to hygiene and sanitation in the piggery premises, only 23% of the respondents cleaned or scrubbed the premises with clean water and disinfectants, while 41% were scrubbing without applying the disinfectants and 34.8% just wept the premises. Deworming of pigs was a regular practice as 82.2% of the respondents reported routine deworming of pigs while a few reported that the price of the dewormer was prohibitive. The most commonly reported pig diseases were piglets' scours (25.3%), piglet anaemia (20.9%), swine respiratory disorders (18.8%), skin disorders (18.5%) and parasitic infestations (16.5%).

Reproduction and production parameters

The results (Table 6) showed that the production and reproduction parameters were sub-optimal by international standards and even, often low than those of pigs in other developing countries in the region and elsewhere. It is noteworthy that most of the pig stock in

this study were exotic breeds (Landrace, Large white, Pieterain) and their crosses and yet their average litter size was comparable with that of local breeds in Vietnam (Lemke et al., 2002) and Kenya (Mutua et al., 2011) where it was 7.3 and 7.8, respectively. On the other hand, improved breeds in Vietnam had an average of 11.2 live born piglets per sow which is much higher than the average reported in this study for improved pigs in Rwanda. Similarly, in Wakiso peri-urban district of Uganda, (Muhanguzi et al., 2012) the litter size of 135 surveyed sows of exotic breeds and their crosses ranged between 6 to 10 piglets (Muhanguzi et al., 2012) which is a bit higher than the average in the current study.

The results of number of farrowing's per sow per year in this study were higher than those of the Mongol (1.8) and ban (1.2) breeds in Vietnam (Lemke et al., 2002). The growth rate of pigs in this study as indicated by average body weight at 9 months was 78.3 kg which is similar to that of large white breed in Western Kenya (Ilatsia et al., 2008) while the reported average age at first farrowing (12 months) was much higher than that of local pigs (8.1 months) in Busia district of Western Kenya (Mutua et al., 2011).

Pig marketing

Results of pig marketing showed that there was minimum specialization in pig production enterprises as most farmers would sell any age group (Table 7) including pre-weaned piglets. However weaners were the most marketed category. This result is in contrast with results by Ouma et al. (2014) in Masaka, Mukono and Kamuli districts in Uganda where it was found that some farmers were highly specialized in production as 25.1% marketed piglets for breeding, 36.1% grown pigs for slaughter and 42.2% of farmers marketed piglets and growers both. Farm gate (68%) was the most common mode of selling whereas others sold the pigs in the nearest public markets (20%) and on contract (12%). Selling of whole live animals predominated as only 8% of the respondents possessed slaughter slabs and 8.1% had cold storage facilities for the carcasses. This was different from the situation in Uganda where it was found that farmers mainly sold the carcasses to neighbourhood

Table 7. Frequency and percentage distribution of marketing responses by age groups.

Age group	Number of respondents	%
Weaners	73	50.3
Piglets	44	32.1
Grower/gilt	57	39.9
Sows	65	41.9

(60%) or to distant butchers (16%) and the rest sold live pigs for breeding or slaughter (Ouma et al., 2014).

In an improved pig marketing system in Kenya, the farmer's choice company limited accepts live pigs brought in by farmers to be slaughtered and then paid according to the weight and lean proportion of the carcasses (FAO, 2012). There is hardly live pig marketing in livestock market as venders search for and slaughter the pigs on the farms or transport live pigs to pig slaughter houses.

Challenges

Most of the respondents (66.8%) reported that feeds (quality and quantity) were the main challenge followed by lack of appropriate breeding stock (43.5%), swine diseases (38.2%), poor market accessibility (37.4%) and lack of efficient credit facilities (26.9%). These results are similar to those reported in Uganda where feeding and lack of market information were most reported as main challenge (Ouma et al., 2014), whereas in Kenya most of the farmers reported low prices of pig products (FAO, 2012) to be the main challenge.

The swine feed challenge in Rwanda can be attributed to the fact that the necessary feedstuffs are often exported to neighbouring countries, imported feeds are very expensive, the animal feed industry is still at low level and there is still a very high competition for feedstuffs with humans and other livestock including fish.

On the other hand, there is no organized swine breeding in Rwanda as there are no pure breeding and cross breeding centres to generate appropriate breeding stock for commercial producers. Artificial insemination in pig is yet to be adopted, appreciated and popularized leaving natural breeding of none descript genotypes to be the norm. However, it is noteworthy that a reasonable proportion of farmers (54%) reported awareness of government policies and programmes aimed at improving agricultural production in general such as Rwanda Vision 2020.

Conclusion

Males are the most involved in pig production, as they represent 80% of farm labour and 85% of farm

managers. Most pig farms are in peri-urban areas (41.9%) where the Landrace is the most reared breed (37.7%). Farmers use natural mating although 81% of the farmers were willing to use artificial insemination if available.

The majority of farmers (72%) kept at least one record and books (82.7%) were the main form of record keeping. However, health record was never kept and small proportion (30%) of farmers had attended training sessions on pig production. Most of the pigsties (64.8%) were semi-permanent structures. Most farmers fed their pigs on commercial feeds (65.9%) which are home made from purchased feedstuff. The maize bran was the most used feedstuff (64%). In all provinces tap water (71.3%) was most commonly used. veterinary services were very commonly used (94.4%), 82% of the farmers routinely deworm their pigs and were also cleaning pigsties (99%) although a few (23%) were cleaning with disinfectant.

Piglet scours was the main disease condition (23.5%) and reproduction parameters were generally low: the litter size is 7.2 and the duration from farrowing to weaning was 2.5 months. Pigs are sold at all age categories and most of them are sold at farm gate, a few numbers of farmers sell by contract. Feeding was reported (66.8%) to be the main challenge faced by pig farmers.

RECOMMENDATIONS

Policy makers, universities, research and extension services and NGOs should target and encourage women to fully participate in pig production as a means of livelihood. Farmers should form cooperatives for joint benefits such as training, access of inputs and marketing. The National Agriculture Research System (NARS) should intensify research and extension on pig production and management through the existing cooperatives so as to skill up pig farmers. Swine demonstration farms should be set up to facilitate research and extension and also to generate the much needed improved breeding materials.

Local available feed stuff such as rice bran, broken rice, maize, soya-beans, cassava, vegetables and distillers' residues should be harnessed to formulate least cost pig rations for each age group, considering the physiological and production levels. The potential role of

non-conventional feedstuffs (vegetable, fruit, swills, forest products, wild vegetables, wild bananas, and wild cola - cassia, yam, Alfa Alfa and other forage grasses) should be documented and shared. To solve the lack of breeding stock the artificial insemination in pig production should be introduced and promoted.

The NARS should help farmers and-all pig farmer cooperatives to develop bankable business plans for accessing bank credits that will be needed to propel the development of the pig industry.

Conflict of Interests

The authors have not declared any conflict of interests.

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REFERENCES

- Ilatsia ED, Githinji MG, Muasya TK, Okenol TO, Kahill AK, (2008). Genetic parameter estimates for growth traits of large white pigs in Kenya. *S. Afr. J. Anim. Sci.* 38(3):166-173.
- FAO (2009). *Farmer's Hand Book on Pig Production for the small holders at village level.* Food and Agriculture Organization, Rome, Italy.
- FAO (2011). *World Livestock 2011, Livestock in food security.* Food and Agriculture Organization, Rome, Italy.
- FAO (2012). *Livestock Country Reviews (3) Pig sector in Kenya.* FAO animal production and health. Food and Agriculture Organization, Rome Italy.
- Lemke U, Thuy LT, Zerate VA, Kaufmann B, Vang ND (2002). Characterization of smallholder pig production systems in mountainous areas of North Vietnam. *Deutcher tropentag DDT* October 9 to 11, Kassel- Witzenhausen.
- ILCA (1992) *Appraisal of indigenous pig production and management practices in Rivers state, Nigeria.* *J. Agric. Soc. Res.* 8(1):1-7.
- Mpofu I, Petrus NP, Schneider MB, Nepembe M (2011). The constraints and potentials of pig production among communal farmers in Etayi Constituency of Namibia. *Livestock Research for Rural Development* 23(7). <http://www.lrrd.cipav.org.co/lrrd23/7/petr23159.htm>
- Mutua FK, Dewey CE, Arimi SM, Schelling E, Ogara WO, Levy M (2011). Reproductive performance of sows in rural communities of Busia and Kakamega Districts, Western Kenya. *Afr. J. Agric. Res.* 6(31):6485-6491.
- Muhanguzi D, Lutwama V, Mwiine FN (2012). Factors that influence pig production in Central Uganda-case study of Nangabo Sub-County, Wakiso district. *Vet. World* 5(6):346-351.
- NISR (2012). *Rwanda National Institute of Statistic, Statistical year book.* Kigali, Rwanda. <http://statistics.gov.rw/publications/statistical-yearbook-2012>
- Ouma E, Dione M, Lule P, Roesel K, Pezo D (2014). Characterization of smallholder pig production systems in Uganda: constraints and opportunities for engaging with market systems. *Livest. Res. Rural Dev.* 26(3):56.
- Vision 2020 EDPRS2 (2013). *Agricultural Policies and Local Grievances in Rural Rwanda* 21(3) 2009. The republic of Rwanda, Kigali Rwanda.
- Whittemore CT (1996). Nutrition reproduction interactions in primiparous sows. *Livestock Production Science* 46(2):65-83.
- Zebus MF, Alexandre G, Diman JL, Paul JL, Despois E, Phaeton E (2005). Diversity of pig farming systems in Guadeloupe. First technical and economic appraisal. *Journées Recherche Porcine* 37:407-412.