



# Determination of Reproduction Performance Parameters of Sows Bred at the Pig Birth Centers of Giheta, Nyabunyegeri and Mahwa in Burundi

ISSN: 2770-6729



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**Submission:**  July 14, 2023  
**Published:**  August 15, 2023

Volume 3 - Issue 1

**How to cite this article:** Butore Joseph\*, Sindaye Daniel, Nimbona Constantin, Kwizera Adrien. Determination of Reproduction Performance Parameters of Sows Bred at the Pig Birth Centers of Giheta, Nyabunyegeri and Mahwa in Burundi. *Clin Res AnimSci.* 3(1). CRAS. 000555. 2023.  
DOI: [10.31031/CRAS.2023.03.000555](https://doi.org/10.31031/CRAS.2023.03.000555)

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## Abstract

An investigator was conducted to evaluate the reproduction performance of sows bred at the birth centers of Giheta, Mahwa et and Nyabunyegeri. A survey questionnaire was elaborated and used to analyze all information about sow's reproduction performance parameters including the litter size at birth, weaning, sex ratio rate, fecundity rate, interval between farrowing, and the interval between farrowing and fertilizing protrusion and the effect of breed on reproduction performance parameters was analyzed. The results showed that there was a significant difference in the interval between farrowing and in the interval between farrowing and fertilizing protrusion ( $p < 0.05$ ) in different pig birth centers. They were longer at the Nyabunyegeri pig birth center compared to Giheta and Mahwa pig birth centers. There is no significant difference between the pig birth centers in terms of fertility and weaning rates ( $p > 0.05$ ). The litter size at birth and weaning are significantly different between the pig birth centers ( $p < 0.05$ ); it was higher at Mahwa and lower at Nyabunyegeri. The average weight of a piglet at weaning is high at Mahwa compared to Nyabunyegeri ( $p < 0.05$ ). Large white breed had a higher number of piglets at birth and weaning at Mahwa pig birth center compared to the Giheta and Nyabunyegeri pig birth centers ( $p < 0.05$ ). The large white breed had higher sow's reproduction performance compared to Duroc and Piétrain breeds. However, good management of the pigsty in different pig birth centers should be recommended.

**Keywords:** Pork production; Farm, Breed; Burundi

## Introduction

Pork (*Sus scrofa domestica*) is one of the oldest animals domesticated by humans [1]. It is an omnivorous monogastric that transforms a very varied range of agricultural products and by-products not consumable by humans into better quality products which is meat [2,3]. It is the only domestic animal to have a high carcass yield (73-80%) and contributes to soil fertilization through its droppings (600-730kg of organic manure per year) [4]. Pig farming has several advantages including: meat production without contributing to the deterioration of natural pastures and very high productivity [5]. They can give birth, after a relatively short gestation period, to large litters, and this, with a very short generation interval [6]; they grow rapidly; their yield in terms of annual meat production per ton of live weight of breeding females is higher than the yield of other farm animals and therefore their profitability is greater [6,7].

Pig farming plays an important role in improving the diet of the human population through its contribution of nutrients from meat and contributes enormously to the increase in the country's development through the income received by the various stakeholders (breeders or the State) [8,9]. The success of pig farming is conditioned by several factors including a good breed (resistant to climate change, diseases, good growth, etc.) [10,11], a balanced diet with good quality [12,13], impeccable hygiene (good cleaning of the animal's housing, and the farm's environment etc.), an appropriate health protection program and regular monitoring (watch over the animals, prevent disease or prevent their spread [14,15].

However, the irregularity in the daily monitoring of all these zootechnical parameters in pig farming conduction is the origin of low pig yield production [10].

In Burundi, pig farming occupies an important place in the increase of Gross Domestic Product (GDP) through its production. In recent years, pork is one of the most consumed animals (735797 pork) by the population [16]. Despite its importance, pork farming remains extensive in Burundi but recently, considerable efforts have been made to develop pig genetic resources. Pig birth centers contribute enormously to the increase in pig yield production through the spread of improved piglet breed (selected breed). This genetic improvement is the result of various research studies carried out by the Burundi Institute for the Agricultural Sciences (ISABU) in collaboration with the University of Burundi on new technical and practical approaches of selection or crossing of pigs that can increase pig yield production. However, most pig farmers do not master the regular monitoring of breeding parameters to make their investment efforts more profitable.

Very few studies have been conducted in Burundi to evaluate the pig's reproductive parameters in order to better popularize technical approaches throughout the country that can improve reproductive parameters for increasing pig production. It is in this context that a study on the evaluation of the sow's reproduction performance parameters in the pig birth centers of Nyabunyegeri, Giheta and Mahwa was proposed. The aim of this research is to determine the level of reproduction performance of sows raised

**Table 1:** Composition of the pig herd during the investigation.

Item	Mahwa	Nyabunyegeri	Giheta
Piglets before weaning	29	16	19
Piglets after weaning	19	15	156
Growing piglets	0	22	0
Sows in service	21	41	33
Boards	4	2	6
<b>Total</b>	<b>73</b>	<b>96</b>	<b>214</b>

The data of Table1 show that there are no growing piglets in Mahwa and Giheta because weaned piglets are intended for diffusion to rural areas. Growing piglets at Nyabunyegeri pig birth center are reserved for the reforming of aged sows. The weaned piglets observed at different birth centers were waiting for the day of diffusion to the rural area.

Management of sows in pig birth centers: The sows raised in the pig birth centers are mainly the Large White, Piétrain and Duroc breeds. They are the breeding sows whose piglets are intended for distribution to rural areas after weaning. The pig breeding system in the birth centers is the modern type where drinking water is distributed ad libitum and feeding is provided 2 times per day. Except Mahwa pig birth center, the mixing feed is done on the basis of the valorization of local ingredients readily available on the market. For the most part, the bromatological nutrients of this feed are not known and controllable. Piglets have free access to suckle their mother until weaning. Boards and sows are bred differently

in these breeding centers in order to know the parameters that require improvement and to establish the protocol for teaching the pig farmers in Burundi. These lessons focus mainly on improving pig yield production as well as the pig birth centers, which are the reference in Burundi pig farming.

Controlling the sow's reproductive performance parameters constitutes an important factor in the success of pig farming [10]. In this research, the reproductive performance parameters taken into consideration are mainly the sexual and estrus cycle, the duration of gestation, parturition, the interval between farrowing and the number of farrowing per year, the prolificity, lactation and breeding of piglets, weaning, weaning methods and choice of breeders (boar/breeding sows).The analysis of the career of breeding sows will allow the various stakeholders in pig farming to adopt a strategy aimed at increasing pig yield production.

## Materials and Methodology

Selection of the study area: Three pig birth centers supervised by the Burundi Institute for Agricultural Sciences (ISABU) in collaboration with the University of Burundi have been selected as an area for testing this research. These three pig centers were chosen because they constitute the reference centers for improved pig production and contribute to the spread of improved bred piglets in Burundi. These three birth centers are Nyabunyegeri, Giheta and Mahwa, respectively. The Composition of the pig herd during data collection is presented in the following table (Table 1).

in their respective boxes. In terms of health, a prophylaxis plan is very often adopted based on the maintenance of the lodges, internal deworming and the fight against ectoparasites. There was no vaccination plan observed and the treatments were carried out by the veterinarians at the birth centers themselves except for complication cases. Regarding the reproductive performance parameters, the selection criteria for choosing sows is the probability of having higher prolificity because of the fort demand of piglets by population. Always in contact with the animals, the veterinarians of various pig birth centers easily recognize the estrus and present the sow to the boar at the appropriate time for protrusion. The diagnosis of gestation is based on non-return in heat within three weeks after mating.

## Data collection

A data collection sheet was developed to record data on the zootechnical reproductive performance of each sow. These parameters are mainly the date of fertilizing protrusion, the date

of farrowing, the litter size, the number of live births, the number of piglets at weaning, the date of weaning and the weight of piglets at weaning. Since the establishment of the pig birth centers (2020), all sow identification sheets with dignity filled with information on these reproductive parameters have been collected and this data has been recorded in each pig birth center.

After recording all the zootechnical reproductive parameters of each sow found in each pig birth center, the general average of each parameter was determined. These data were used to calculate gestation time, the interval between farrowing, the fertility rate, the average number of piglets per litter at birth, the average number of piglets per litter at weaning, the sex ratio, the interval between fertilizing protrusion and weaning, the average weight of piglets at weaning, the weaning age and the effect of the breed on zootechnical reproductive parameters.

**Interval between farrowing:** Very closely related to the technique of heat detection is the conditions for the annual number of female farrowing. The interval between farrowing breaks down into gestation time, the interval between birth-weaning and the interval between weaning and fertilizing protrusion. In our research work, these data were calculated after the dates on each sow identification sheet were recorded.

**Average prolificity:** It refers to the average number of piglets born alive per litter. On the basis of the data on each sow identification sheet, the number of male and female piglets per litter born alive at birth and weaning was recorded in each birth center. The withdrawal rate, sex ratio at birth and weaning were calculated using the following formulas:

Weaning rate = (number of weaned piglets/number of piglets at birth) x 100.

Sex ratio at birth = number of male piglets at birth/total number of piglets at birth.

Weaning sex-ratio = number of male piglets at weaning /total number of weaning piglets.

**Table 2:** Comparative analysis of piglet's production in pig birth center.

Item	Nyabunyegeri	Giheta	Mahwa	p-value
Litter size at born	7.68±2.47 <sup>b</sup>	8.31±2.43 <sup>b</sup>	10.03±2.85 <sup>a</sup>	0.00
Number of males born per litter	4.01±1.84 <sup>b</sup>	4.02±1.86 <sup>b</sup>	5.26±2.52 <sup>a</sup>	0.00
Number of females born per litter	3.63±1.92 <sup>b</sup>	4.75±2.10 <sup>b</sup>	4.54±2.23 <sup>a</sup>	0.00
Litter size at weaning	6.46±2.13	6.79±2.62	9.40±2.58	0.00
Number of males weaned per litter	3.22±1.50 <sup>b</sup>	3.52±1.75 <sup>b</sup>	4.96±2.18 <sup>a</sup>	0.01
Number of females weaned per litter	3.23±1.85 <sup>b</sup>	3.25±1.60 <sup>b</sup>	4.43±2.02 <sup>a</sup>	0.00
Piglets wheight at weaning	5.86±1.30 <sup>b</sup>	-	12.20±2.08 <sup>a</sup>	0.00

The results of Table 3 reveal that the number of males piglets weaned is greater than the number of female piglets produced at each birth center (% of males more than 50%). There is a significant difference between the interval between farrowing and the interval between farrowing and fertilizing protrusion (p<0.05).

Fertility rate = (number of sows becoming pregnancy/total sows number mated) x 100.

**Comparison of pig breeds:** As not all pig birth centers breed the same breeds, the effect of the breed on the sow's reproductive performance parameters at the different pig birth centers was tested. Data on the zootechnical reproductive performance of each sow breed obtained at each pig birth center were compared with other data from the other breeding centers. The breeds are identified, which serves as tools for comparing these parameters are the Large White, Duroc and the Piétrain breeds.

### Statistical analysis

The data was saved in Microsoft Excel before being statistically analyzed by using SPSS Software version 25 with One -Way ANOVA proceeding by linear polynomial model. Multiple comparisons of means were made with the Duncan method. The data analyzed were recorded in the tables as the mean ± standard deviation and the probability of p<0.05 was considered as significant.

## Result

### Prolificity

The prolificity of sow is defined in practice by the number of "total born" piglets produced per litter. Table 2 describes a comparative analysis of the average piglet production per litter at Nyabunyegeri, Giheta and Mahwa pig birth centers.

The results in Table 2 showed that the size of the litter at birth and weaning, the number of males or females per litter are significantly different between pig birth centers (p<0.05). Pig production per litter is higher at Mahwa but lower at Nyabunyegeri. The average weight of a piglet at weaning is higher at Mahwa compared to Nyabunyegeri and there is no average weight of a piglet at Giheta due to the non-recording of data on the average weight of piglets. Table 3 presents a comparative analysis of the different parameters calculated on the basis of the size of the litter and the different dates recorded at Nyabunyegeri, Giheta and Mahwa birth centers.

The interval between farrowing and the interval between farrowing and fertilizing protrusion are longer at Nyabunyegeri and shorter at Giheta. There is no significant difference between the pig birth center Nyabunyegeri, Giheta and Mahwa in terms of fertility and weaning rates (p>0.05).

**Table 3:** Comparison of sow reproduction parameters in pig birth center.

Item	Nyabunyegeri	Giheta	Mahwa	p-value
Interval between farrowing and fertilizing protrusion	74.35±20.19 <sup>a</sup>	55.21±15.29 <sup>b</sup>	60.00±5.15 <sup>b</sup>	0.00
Interval between farrowing	184.42±27.87 <sup>a</sup>	166.46±23.33 <sup>b</sup>	174.23±7.62 <sup>b</sup>	0.01
Piglets weaning rate in %	89.31±40.85	82.64±23.50	94.13±9.63	0.067
Sex- ratio at born (% of males)	56.71±43.93	47.83±16.65	52,15±17.31	0.259
Sex- ratio rate at weaning (% of males)	50.64±20.52	50.95±18.93	52.78±16.61	0.733
Fertility rate	97.37±16.11	97.92±14.43	99.31±0.00	0.328

### Effect of breed on reproduction performance

The breed plays a very important factor in improving a sow's reproduction performance. Table 4 shows the effect of large white breed on the zootechnical parameters of a sow's reproduction in the pig birth center of Nyabunyegeri, Giheta and Mahwa.

The results of Table 4 showed that large white breed had a high production of piglets (number of piglets at birth and weaning) at

Mahwa birth center compared to the Giheta and Nyabunyegeri pig birth centers ( $p < 0.05$ ). The interval between farrowing and the interval between farrowing and fertilizing protrusion were short at Mahwa pig birth center, but they are longer at Nyabunyegeri and Giheta birth centers ( $p < 0.05$ ). The average weight of a piglet at weaning is high at Mahwa compared to Nyabunyegeri birth center ( $p < 0.05$ ). Table 5 shows the effect of the Duroc breed on sow production parameters in different pig birth centers.

**Table 4:** Effect of Large white breed on sow reproduction parameters in pig birth center.

Item	Mahwa	Giheta	Nyabunyegeri	p-value
Litter size at born	10.75±3.05 <sup>a</sup>	8.64±2.42 <sup>b</sup>	7.78±2.57 <sup>b</sup>	0.000
Number of males born per litter	6.25±3.03 <sup>a</sup>	4.35±1.92 <sup>b</sup>	4.11±1.88 <sup>b</sup>	0.000
Number of females born per litter	4.50±2.03	3.89±1.77	3.62±2.01	0.100
Number of males weaned per litter	5.80±2.61 <sup>a</sup>	3.75±1.73 <sup>b</sup>	3.31±1.49 <sup>b</sup>	0.000
Number of females born per litter	4.30±1.90 <sup>a</sup>	3.21±1.59 <sup>b</sup>	3.23±1.91 <sup>b</sup>	0.014
Litter size at weaning	10.11±2.57 <sup>a</sup>	6.96±2.45 <sup>b</sup>	6.55±2.12 <sup>b</sup>	0.000
Sex- ratio (males) at born	0.567±0.19	0.498±0.14	0.580±0.45	0.581
Sex- ratio (males) at weaning	0.561±0.18	0.553±0.17	0.521±0.20	0.546
Piglets weaning rate %	94.78±8.89	81.03±21.59	90.02±41.85	0.235
Piglets weight at weaning	10.60±2.03 <sup>a</sup>	-	5.86±1.30 <sup>b</sup>	0.017
Interval between farrowing and fertilizing protrusion	63.13±327 <sup>b</sup>	52.83±9.19 <sup>b</sup>	74.34±20.99 <sup>a</sup>	0.026
Interval between farrowing	169.18±7.69 <sup>b</sup>	163.66±28.98 <sup>b</sup>	184.42±27.87 <sup>a</sup>	0.032

The results of Table 5 indicate that there is no sow of the Duroc breed at Nyabunyegeri birth center. With the exception of the interval between farrowing and the interval between weaning and fertilizing protrusion, Mahwa pig birth center has a high level of other reproductive performance parameters compared to Giheta

birth center. A significant difference is observed in the interval between farrowing, the interval between weaning and fertilizing protrusion, the weaning rate, the number of piglets at the time of weaning and the number of males at the time of weaning ( $p < 0.05$ ).

**Table 5:** Effect of Duroc breed on sow's reproduction parameters in pig birth center.

Item	Mahwa	Giheta	Nyabunyegeri	p-value
Litter size at born	9.67±2.62	8.50±2.88	-	0.333
Number of males born per litter	5.10±2.21	3.66±1.86	-	0.149
Number of females born per litter	4.57±2.02	3.33±2.06	-	0.145
Number of males weaned per litter	4.78±1.89 <sup>a</sup>	3.00±1.41 <sup>b</sup>	-	0.037
Number of females born per litter	4.42±1.93	3.33±2.06	-	0.222
Litter size at weaning	9.21±2.34 <sup>a</sup>	6.33±3.38 <sup>b</sup>	-	0.017
Sex- ratio (males) at born	0.52±0.16	0.46±0.19	-	0.389
Sex- ratio (males) at weaning	0.52±0.15	0.49±0.09	-	0.745
Piglets weaning rate %	95.85±6.95 <sup>a</sup>	77.28±12.25 <sup>b</sup>	-	0.004
Piglets weight at weaning	11.44±3.13	-	-	

Interval between farrowing and fertilizing protrusion	69.05±5.17 <sup>a</sup>	56.05±17.09 <sup>b</sup>	-	0.002
Interval between farrowing	179.19±14.05 <sup>a</sup>	167.30±22.19 <sup>b</sup>	-	0.016

The piétrain breed was observed only at Mahwa birth center and the results found to this breed showed that the average number of piglets per litter at birth and weaning were 7.75±2.62 and 5.80±2.61, respectively. These results are lower compared to those of the white and Duroc breeds.

## Discussion

The results of this research showed that the litter size of the sow at birth and weaning, the number of males or females per litter and the weight of the piglets at weaning are significantly different between pig birth centers ( $p < 0.05$ ). This difference could be influenced by environmental factors, in particular diet and breed [17-20]. This is justified by the number of piglets per litter which is higher at Mahwa pig birth center and lower at Nyabunyegegi pig birth center. Sow feeding at Mahwa birth center meets the standards recommended by NRC 1998 (Standard Requirement for Swine Nutrition) while at Nyabunyegegi and Giheta pig birth centers; sows are fed on the basis of local ingredients whose bromatological nutrients are, in some cases, unknown. Mahwa sow breeds are 100% pure genetically but for other birth centers the degeneration of their breeds could be suspected. Such results are similar to the work of other researchers who had reported that the litter size of a sow is influenced by breed, diet and local environment [19, 21-23]. However, previous research had shown that adjusting nutritional intakes as closely as possible to needs during lactation maximizes milk production and piglet growth; while minimizing the risk of developing reproductive problems after weaning, which are often associated with excessive mobilization of body reserves [20,24,25].

The interval between farrowing and the interval between farrowing and fertilizing protrusion are significantly different between the birth centers ( $p < 0.05$ ). This difference could be influenced by two very important factors, particularly the diet and weaning age [19,20,23,24]. The weaning age of the piglets is about two months (60 days) at the Mahwa pig birth center, 45 days at Giheta pig birth center and 45 to 60 days at Nyabunyegegi pig birth center. As for the diet, the recommended nutritional intakes at the Mahwa pig birth center significantly reduce the time between weaning and fertilizing protrusion (3-5 days in most cases) compared to the Giheta and Nyabunyegegi pig birth centers. These results are similar to the work of other researchers who had shown that a good diet of breeding sows is a primary factor in reducing the time between weaning and fertilizing protrusion [20,25,26].

The breeds studied (Large White, Duroc and Piétrain) were not found in each pig birth center. All of these breeds are found at the Mahwa birth center because it is a national zootechnical research station whose mission is to conserve animal genetic resources and study the adaptability of new breeds introduced to Burundi. The Large White breed is found in all birth centers due to its higher prolificity compared to the Duroc and Piétrain breeds [27-29]. This is confirmed by the results of this research which showed that the number of piglets per litter at birth and weaning is higher for

Large White breed compared to Duroc and Piétrain breeds. This high prolificity is very important for these pig birth centers as well as their objective is to optimize their economic profitability. This attitude of pig birth centers is understandable and justified given that their mission is to spread weaned piglets through the sale of these piglets to the rural environment. These results coincide with other research that had shown that optimizing economic profitability is the goal of every farm [1,18,28]. Despite the absence of the Piétrain breed in all pig birth centers, it is much more appreciated by the rural population in Burundi due to its greatest resistance to various environmental factors but also to the quality of its meat. The rural population largely owns the last two breeds (Large White and Piétrain) or the crossing of these two breeds for an improvement in their pig production. The Piétrain breed was introduced in Burundi for many years ago and nowadays is considered as a local breed due to its degeneration. However, the conservation of Piétrain's potential genetic explains the presence of this breed at Mahwa pig birth center.

The weaning rate of the Duroc breed is significantly lower in Giheta birth center compared to Mahwa pig birth center. This difference was conditioned by environmental factors, in particular the poor management of pigsty after the piglet's birth. The piglets that die of asphyxiation due to lack of oxygen when their mothers sleep above them when farm workers are not in their vicinity, the cannibalism of the sow towards its descendants (piglets) just after birth and the conditions in which the pigsty is built. Such events are the same as in other pig farms when efforts are no longer combined for optimizing pig production [30,31].

## Conclusion

In Burundi, pig birth centers contribute enormously to the diffusion of improved piglet's breed. The large white breed has higher reproduction performance compared to other breeds and easily adapts to all pig birth centers already identified. Good management of the pigsty in these pig birth centers should be recommended as well as environmental factors in particular feeding, management of piglets after birth and improvement of degenerated breeds are the main challenges facing pig farming in these pig birth centers. The crossing between Large White breed and Piétrain breed could be proposed because of the preference of Piétrain breed by the local population to increase pig production in Burundi.

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