Assessment of the Profitability Window of Broiler Chickens Farming in Bobo-Dioulasso, Burkina Faso

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Abstract**—** *The purpose of this study, was to determine the optimal size for broiler farming and the optimal hen's raising time to achieve technically and economically profitable farming .The study was conducted in the suburban area of Bobo-Dioulasso where three groups of six broiler farms were identified: the 1st group was made of farms that had 200 to 400 heads, the 2nd group had between 400 to 600 heads, and the 3rd group had more than 1000 heads.. In each group, three farms had completed the hen raising within 35 days and the other three within 42 days. We found that among the chicken coops, 17% respected the building orientation standards and most had low roofs (< 2.5 m) with a short extended eave (< 1 m) and a low dwarf wall (< 20 cm). Almost all of the producers (94.4%) used concomitantly a feed formula and a vaccination schedule. In terms of conduct, crawl space, lighting, preheating and heating were effective on all farms. In fact, 72.2% used coal-fired heaters, 16.7% radiant heater and 11.1% heating bulbs. Upon installation of the chicks (day 1), 76.5% of producers were administering veterinary products. In terms of good density of feeding and watering material, 61% were met at start-up, 43% at growth and 29% at finish. For those who observed the recommended density standards, 88.89% were encountered at start-up, 44% at growth and 5.2% at finish. The highest mortalities and average live weights (AVL) were found on large farms and 42 days raising while the highest Feed conversion ratios (FCR) were recorded in farms with 35 days of driving. The highest chicken production costs were seen in smaller flocks (1831±233) and the larger the flock size at finish, the better the profit (822 ± 151). In conclusion, the category of flock size that allowed the highest benefit for farmers in the suburban area of Bobo-Dioulasso is the group had more than 1000 heads and therefore should be recommended for extension purpose.*

Keywords**— *Bobo-Dioulasso-Burkina Faso, Norms, broiler Chickens, profitability.***

I. INTRODUCTION

In Burkina Faso, the livestock sub-sector contributes 18.8% to GDP, 14.2% to exports, 38.8% to the formation of monetary income of rural households (MRA and UNDP, 2011) whereas poultry occupies a special place (DGPSE, 2010). In urban centers, semi-intensive poultry farming is a source of employment and provides workers with substantial income. In addition, poultry farming creates salaried jobs and contributes to the reduction of unemployment among youth. Also, poultry is the main source of animal proteins supply for populations (CILSS, 2006: Pousga *et al.*, 2019). However, total meat consumption in Burkina Faso is estimated on average at approximately 9 kg/inhabitant/year (PNSAN, 2013). This consumption is insufficient compared to the 21 kg of meat/person/year recommended (FAO, 2008). Indeed, the supply of meat is mainly ensured by endogenous extensive poultry farming which is characterized by its low productivity (Pousga *et al.*, 2019). Faced with an increase in the population, especially in urban area and the multiplication of mining sites, it becomes urgent to ensure a massive and rapid production of meat in order to cover the needs in animal proteins (Coulibaly, 2014). Modern poultry farming, including the production of broilers, seems to be a palliative solution (Hassan *et al.*, 2017, Hien *et al.*, 2018). However, the production of this chicken faces certain difficulties such as avian diseases, poor diet and poor housing (Amadou *et al.*, 2012). Actions that favored modern poultry farming and broiler chickens in particular remain insufficient and production still can't meet the growing needs of the market. Regarding the important economic and social role that chicken especially broiler chickens can play through its growth rate, further improvement actions, are necessary to sustainably increase its production. Our hypothesis was that the increased production would occur if farmers are able to derive a substantia financial advantage from the activity, which requires a good mastering of technical production route and better management of the inputs used. Our study therefore aims to determine the size of the broiler farm and the raising time-laps for achieving a technically and economically profitable farming in Bobo-Dioulasso suburban area.

II. MATERIAL AND METHODS

2.1 Study area

The study was undertook in Bobo-Dioulasso, capital of Houet province and the Hauts-Bassins region. The city is located in a south-Sudanian climate zone, characterized by average annual rainfall of between 900 and 1200 mm, and influenced by a dry season (October to April) and a rainy season (May to September). The dry season is composed of a cold period from late November to early February and a hot period from late February to April. The temperature varies from season to season and is (between 15 °C and 45 °C with an average of 28 °C.

2.2 Methods

2.2.1 Monitoring of farms

The method used was adapted from FAO's (1994) and was successfully used by Barakasa (1998), Some (2008) and Ouedraogo (2017). Briefly, the study took place in two (02) phases. (1) The first part consisted of inventory of the farmers involved in the production of broilers in Bobo-Dioulasso; (2) The second phase consisted of carrying out the monitoring at henhouses level. After the necessary explanations, the farmer themselves, with our support, followed the parameters of the birds. The monitoring period time-lapsed from October and December 2017 and concerned eighteen (18) producers installed in the commune, of which: six small farmers had a flock of 200-400 heads among which three (03) raised the broilers in 35 days and the other three in 42 days; six other medium farmers had a flock of between 400 and 600 heads of which three carried out raising in 35 days and the other three in 42 days; finally, the six (06) remaining big farmers had a flock of more than 1000 heads, of which three carried out their rearing in 35 days and the other three in 42 days. The parameters considered were: mortality, growth, feed conversion ratio, profitability of the activity.

2.2.2 Data Analysis

For analysis, data processing and generation of graphics, we used SPHINX v4.5, XLSTAT v2007.7 and EXCEL 2013 software's. The analysis of variance (ANOVA) was done and comparison of the means between the parameters (number of days of rearing and number of animals) was carried out using Fisher's test at the 5% threshold. For economic performances, we carried out an analysis of the profit by bands in each farm. The results obtained were subdivided into variable, structural costs and income. In terms of products, they corresponded to the income from the sale of chickens and manure at the end of the batch rearing. The sale was made per head at 2,250 CFA and 1,000 CFA/100 kg of manure. The total products were obtained by adding the sale of chicken and sale of manure.

Feed intake (FI)

FI= (FDD-FR)/ (Total number of animal): FDD = food distributed daily; FR= food refusal.

Feed conversion ratio (FCR) is the conventional measure of livestock production efficiency: the weight of feed intake divided by weight gained by the animal

FCR= FI/ (Weight gained)

Mortality= (Number of deaths in the batch)/ (Group size at the start of the experiment); Mortalities were recorded daily

With regard to economic profitability, the following formulas have been used: Avec FIt = the total Food Quantity Ingested by phase (Start-up, growth and finish).

Food cost / phase = FI * price per kg of food

Food cost = Σ food cost / phase

Chicken selling price = PV * price per kg at the farm

Sale of chickens = Number of chickens * selling price of chicken

Depreciation = ((Equipment acquisition cost))/ ((Number of years of depreciation))*((number of days of breeding))/ ((365 days))

Production cost = Σ expenses

Profits = income-expenses

Chicken profit = (Total profit) / (Number of chickens sold)

Chicken production cost = (Σ C) / (Number of chickens sold)

III. RESULT AND DISCUSSIONS

3.1 Result

3.1.1 Farming standards

3.1.1.1 Buildings

Among the eighteen (18) farmers involved in the study, the majority had their buildings located on the farm (61.1%), against 38.9% who had their buildings at home. The largest coop had 198 m2 with a length of 22 m, a width of 9 m, and a height of 4 m although the smallest coop had 8 m2 with a length of 4 m, a width of 2 m and a height of 2 m. Most of the coops had metal sheet roofs, were low (< 2.5 m) with a short extended eave (< 1 m) and a short wall of less than 20 cm height. All of the buildings had a concrete terrace. Some rare buildings had a capped roof. Also, only 17% of these buildings met the east-west orientation standards with the north-south openings which are the standards recommended in tropical countries. Almost all of the farm buildings involved in the study had fences and tarpaulins. Ventilation was natural in all eighteen (18) farm buildings.

3.1.1.2 Farming equipment

The use of light bulbs was effective in all buildings. The majority of poultry farmers (77.8%) regularly used a scale in their farms. The distribution of different heating materials used in hen houses were represented (Fig. 1). Briefly, 72.2% used coal-fired heaters, 16.7% radiant heater and 11.1% heating bulbs. The most widely used feeders in animal husbandry were plates, cone feeders and linear feeders. For the drinkers, we had the cone type which was used in all farms whose capacity was dependent on the age of the chicken. The most common litter on all farms was wood shavings.

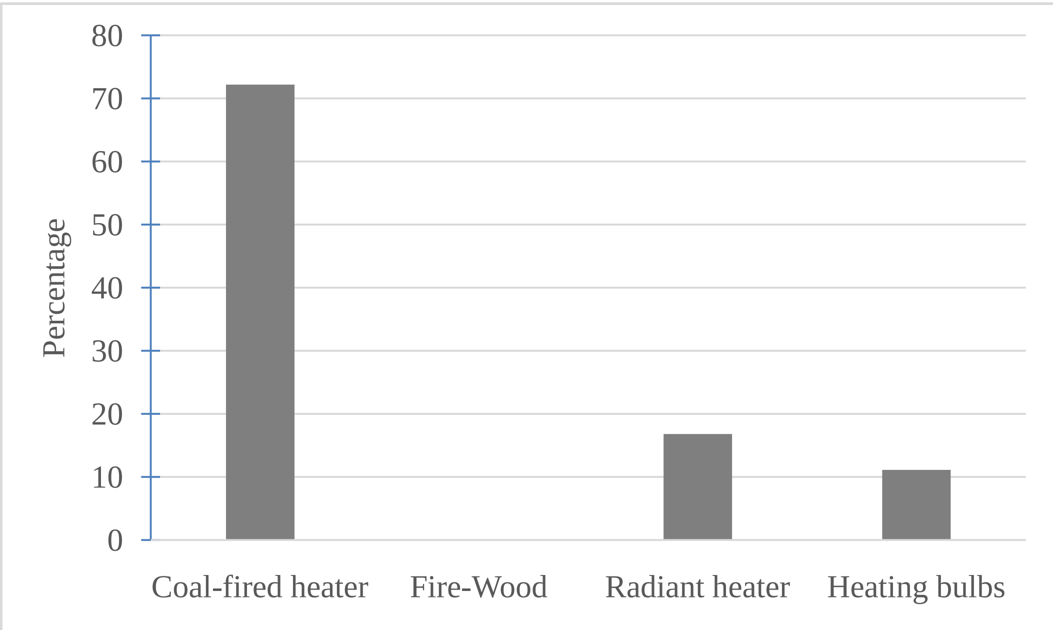

FIGURE 1: Heating source distribution

3.1.1.3 Feeding and watering

Almost all (94.4%) of farmers formulated ration themselves. Among farmers making their own poultry feed, 53.3% of them used three (03) different formulas depending on the stages of production (starter, growth, finishing) and 46.7% of them used two (02) formulas (starter and grow-finishing). Most of ration contained maize, cottonseed meal, fish meal, methionine and lysine. Figure 2 shows how the food is distributed in the different buildings. We have 27.78% of farmers who had specific feed times versus 72.22% who feed their broiler chickens ad libitum (Fig. 2).

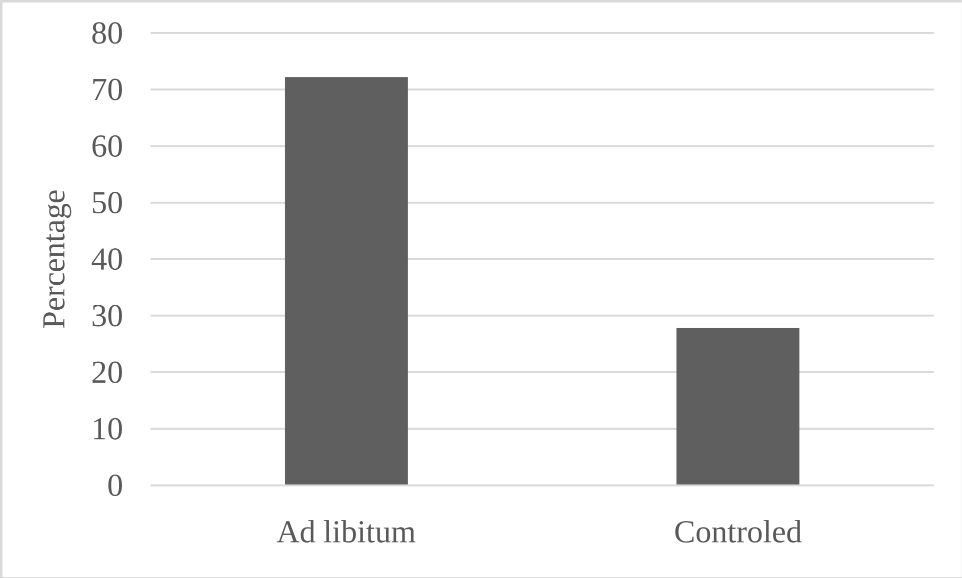

FIGURE 2: Regime of food distribution

3.1.1.4 Health monitoring

The most commonly used disinfectants were: bleach, Virkon and lime. Veterinary products used in almost all poultry farms included: anti-stress, vaccines against Newcastle disease, Infectious bursal disease and infectious bronchitis; Anticoccidial drugs and antibiotics against respiratory diseases, vitamin ABs used by some producers (11%) were administered under the supervision of veterinary agents.

3.1.1.5 Farm management

The production of broiler chickens was dominated by new farmers. In terms of management, it appears that 100% of farmers respected a crawl space lasting between three (03) days to a month. During this crawl space, hen-house, feeders and drinkers were disinfected. More than ¾ of famers (76.5%) administered veterinary medication as soon as the chicks arrived (on day-1) and 100% were distributing feed to the chicks from the first day of their installation. Heating was effective in all farms during start-up and continues in 11.1% of farms during growth. This heating is a function of temperature in 66.7% of farmers. A few farmers had thermometers in their coops to record the temperature. The proportion of farmers that respected density of feeders and drinkers in farms was represented (Fig. 3). Indeed, 61% complied with the standards of 50 chicks per feeder and / or drinkers at start-up, 43% the standard of 30 chickens per feeders and / or drinkers with growth and only 29% had a workforce of 10 chickens per feeder and / or drinkers at the finish.

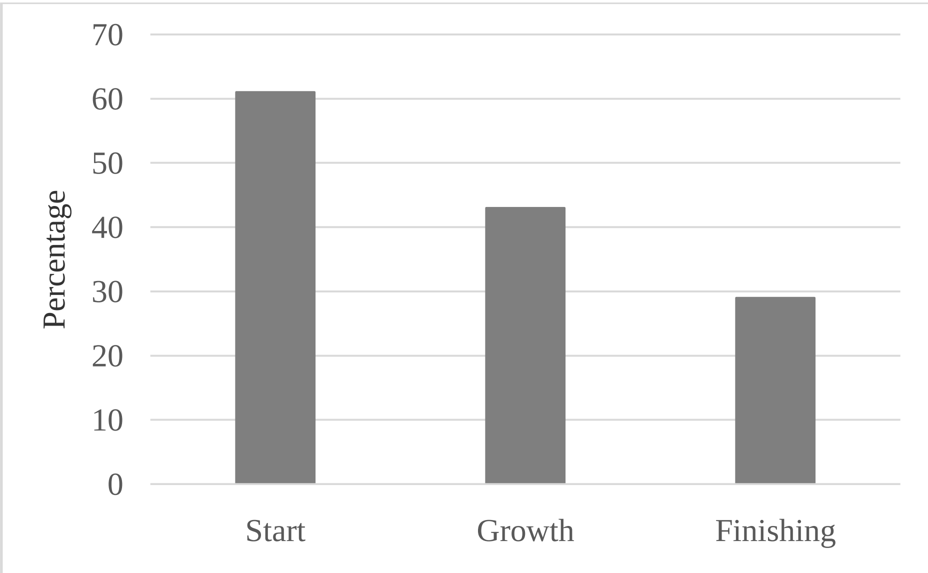

FIGURE 3: Compliance with the norms of density for feeding's material

Density of chickens in buildings showed (Fig. 4). In total, 88.89% of the farmers had a good density at the start (20 to 30 chicks per m²), 44.4% at growth (10 to 20 chicks per m²) and only 5.2% in the finish (8 to 10 chicks per m²).

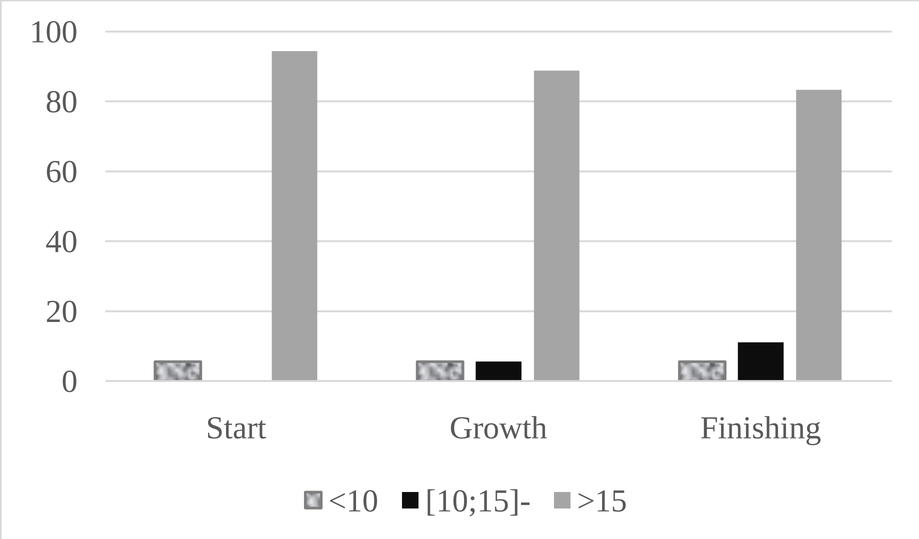

FIGURE 4: Compliance with density standards for chickens in buildings (number/m²)

3.2 Zootechnical performance

3.2.1 Mortality

Table 1 showed the mortality rates according to stage and size of the farm. We found that they are higher at start-up and in large numbers.

TABLE 1
MORTALITY RATE (%) DEPENDING ON THE STAGE AND SIZE OF THE FARM

Designations	Farm size (head)			P Value
	200 - 400	400 - 600	1000 plus	
M. R. at Start-up (%)	1,36 ± 0,91 [a]	1,37 ± 0,42 [a]	2,21 ± 1,33 [a]	0,26
M. R. at growth (%)	0,63 ± 0,37 [a]	0,26 ± 0,48 [a]	0,41 ± 0,23 [a]	0,27
M. R. at finishing (%)	0,16 ± 0,46 [a]	0,13 ± 0,32 [a]	0,81 ± 0,66 [a]	0,05

On the same line, the values with the same letters (superscript) do not differ significantly (p> 0.05); significant at the 5% level (p <0.05).M. R.: Mortality rate

3.2.2 Average live weight

The average live weight (ALW) in 35 and 42 days relative to the total is presented in Table 2. For farm size between 200 and 400 heads, we recorded a MLW of 1600.6 g and 1766.6 g respectively for 35 days and 42 days. For farm size more than 400 heads, we noticed that the MLW did not vary regardless of the number of raising days. It is 1650 g at 35 days and 1966.6 g at 42 days.

TABLE 2
AVERAGE LIVE WEIGHT AT 35 DAYS AND 42 DAYS DEPENDING ON THE FARM SIZE

Designations	Farm size (head)			P Value
	200 - 400	400 - 600	1000 et plus	
ALW (g) à 35 days	1600,66 ±217,25 [a]	1650 ±86,6 [a]	1650 ±132,28 [a]	0,9
ALW (g) à 42 days	1766,66 ±208,16 [a]	1966,66 ±642,91[a]	1966,66 ±635,08 [a]	0,87

On the same line, the values with the same letters (superscript) do not differ significantly (p> 0.05); Significant at the 5% level (p <0.05). ALW: Mean live weight

3.2.3 Feed conversion ratio (FCR)

The Feed conversion ratio (FCR) in 35 and 42 days depending on raising days are shown in Table 3. We observed that FCRs grew with flock size. The higher the flock was, the higher the FCR was. It appears that the 35-day Feed conversion ratio (FCR) are higher than those of 42 days.

TABLE 3
FEED CONVERSION RATIO (FCR) EN FONCTION DE LA TAILLE DE L'ÉLEVAGE

Designations	Farm size (head)			P Value
	200 - 400	400 - 600	1000 plus	
FCR (35 Days)	1,53 ± 0,68 [a]	1,70 ± 0,2 [a]	1,93 ± 0,15 [a]	0,06
FCR (42 Days)	1,43 ± 0,25 [a]	1,63 ± 0,21[a]	1,63 ±0,25 [a]	0,95

On the same line, the values with the same letters (superscript) do not differ significantly (p> 0.05); Significant at the 5% level (p <0.05). FCR: Feed conversion ratio

3.3 Assessment of financial profitability

3.3.1 Balance sheet

Table 4 recapitulates the products and expenses to give the profit of chicken by type of production.

TABLE 5
BALANCE SHEET

Designations		Income	Production cost	Profits	Broiler production cost	Chicken selling price	Chicken profit
Farm size	Days						
1 500	42	3 333 250	2 193 247	1 188 250	1 484	2 306	822
200	35	503 500	400 093	103 407	2 052	2 582	530
500	35	1 136 500	685 617	450 883	1 388	2 300	912
500	35	1 121 250	887 000	234 250	1 800	2 274	474
1 400	42	3 151 500	2 389 004	762 496	1 739	2 294	555
300	42	708 000	480 753	227 247	1 658	2 441	783
600	42	1 381 200	946 100	435 100	1 540	2 325	785
325	35	718 750	499 581	219 169	1 586	2 282	696
500	42	1 120 750	792 343	328 407	1 585	2 283	698
250	35	565 500	455 999	109 501	1 854	2 299	445
250	42	693 750	525 284	168 466	2 100	2 775	675
1 255	35	3 437 250	2 331 856	1 105 394	1 882	2 774	892
300	42	680 750	470 481	210 269	1 574	2 277	703
500	42	1 152 500	900 167	252 333	1 837	2 352	515
500	35	1 230 000	754 064	475 936	1 558	2 541	983
1 200	42	2 623 750	1 989 530	634 220	1 778	2 345	567
1 000	35	2 490 000	1 749 517	740 483	1 807	2 572	765
1 100	35	2 715 000	1 919 867	795 133	1 815	2 566	751

3.3.2 Analysis of the balance sheet

3.3.2.1 Production cost

The production cost per head of broiler chicken is given in Table 5. We noticed that the cost of production per broiler chicken according to flock size was zigzagging. The production cost varied from 1582 to 1835 CFA.

TABLE 5
PRODUCTION COST PER HEAD OF CHICKEN (CFA) DEPENDING ON THE SIZE OF THE FARM

Designations	Farm size (head)			P Value
	200 - 400	400 - 600	1000 plus	
PC at 35 days (CFA)	1830,66 ± 233,87 [a]	1582 ± 207,04 [a]	1835 ± 41,18 [a]	0,22
PC at 42 days (CFA)	1777,33 ± 282,57 [a]	1654 ± 160,07 [a]	1667 ± 159,67 [a]	0,74

On the same line, the values with the same letters (superscript) do not differ significantly (p> 0.05); Significant at the 5% level (p <0.05); PC. : Production cost

3.3.2.2 Broiler price

The selling price of broilers in relation to the flock size (Table 6) increased with flock size. Also, according to the raising days those who have a number of 42-day of raising sold broiler at a lower price than those limited to 35 days.

TABLE 6
BROILER CHICKEN PRICE (CFA) DEPENDING ON THE FARM

Designations	Farm size (head)			P Value
	200 - 400	400 - 600	1000 plus	
BP (CFA) 35 days	2497,66 ± 253,78 [a]	2371,66 ± 147,22 [a]	2637,33 ± 118,39 [a]	0,11
PB(CFA) 42 days	2387,66 ± 168,51[a]	2320 ± 34,77 [a]	2315 ± 26,66 [a]	0,3

On the same line, the values with the same letters (superscript) do not differ significantly (p> 0.05); Significant at the 5% level (p <0.05). BP: Broiler chicken price

3.4 Discussions

In Burkina Faso, several studies were carried out on broilers, but most often focused on diet, zootechnical parameters and health. Herein, in addition to these aspects, emphasis has been placed on profitability. The study has limitations because not all the expected performance of the chickens was achieved due to poor management of poultry farms. The farmer must have a good technical skill in order to avoid errors which could introduce pathologies and reduce performance and profitability of broilers (Cauquelin, 1957). The results of our work nevertheless constitute basic data for possible studies to improve the zootechnical and economic performance of broiler chicken farming in Burkina Faso.

3.4.1 Mortality

The mortality rates varied from 1.76% to 3.43%, and were less than the supposed accepted range (5 to 8%) (CIRAD, 2002). Also, others authors found similar mortality rates results: 1.2% with the Cobb 500 (Sanon, 2009); 2.5% with the Ross (Ouattara, 2008); and 3.5% (Ntivuguruzwa, 2008). These results were lower than mortality observed: 5.95% (Gnodogo, 2013); 8.82% (Kinda, 2014) 10.2% (Zongo, 2016) with Cobb500. These low mortality rates obtained might be due to the season that was be supposed to be advantageous for broiler farming. This agrees with Betene (2006) who finds that the mortality rate of broilers is low in the cold season (8%) compared to the hot season (12%). The highest mortality rates were recorded during start-up and in big flock. This is justified by the fact that the start-up is considered a delicate phase, since the sensitivity to pathogens of chicks is high. In addition, their immune system is still undeveloped. According to Kinda (2014), the day-old chick is very fragile, it does not have its mother to warm it nor still enough possibility of defense against the cold. It is therefore essential that the farmer provides appropriate heating.

3.4.2 Average live weight

The highest average live weight was recorded on large farms where raising days were set for 42. The Average live weight (ALW) obtained (1600.6 to 1966.6 g) complied with those indicated in Mémento de l' agronome (CIRAD, 2002) (1600 to 1900 g) for tropical countries. These ALWs were similar to those observed in previous studies that varied between 1660 to 1743.8 g (Ngueba, 2006; Ouedraogo, 2017). Betene (2006) found lower performances of 1111.47 g in the hot season and 1159.02 g in the cold season. We should notice that other researchers obtained higher ALW: 2120.2-2280.4 g (Ciewe, 2006); 2405.2- 2501.9 g (Ntivuguruzwa, 2008); 2242-2328 g (Sanon, 2009); and 2085.8-2126.1 g (Sanni, 2014). These weight differences could be explained by disrespect of norms in poultry farming and especially the quality of the food distributed.

3. 4. 3. Feed conversion ratio

The feed conversion ratio (FCR) is an important economic criterion on the efficiency of food. The results obtained (1.4; 1.7 and 1.9 respectively for flock sizes of 200-400, 400-600 and 1000 in 35-days raising plan) showed that the FCR increases with the size of the flock. This may be justified by the fact that FCR can be overestimated during each week since it incorporates the losses linked to the wastage of the number of chicken and the errors of estimation on the real weight of the food used. Also, only 27.78% of farmers controlled the feed of broilers against 72.22% that feed ad libitum. In addition, the average FCR in 42 days (1.43) remains low compared to that of 35 days rearing plan (1.93). This proves that broilers valued the food better in 42 days than in 35 days raising plans. Most broilers in 35 days plan began with starter feed instead of the pre-start feed. This could cause the chicks to not value the feed well (Brian, 2019). These values are opposite to those of Betene (2006) and Zongo (2016) which reveal that the FCR increase with the number of days of rearing. In fact the chicks suffered a lot from long way transport and arrived too tired. AVIAGEN (2012) noticed that such a difficulty could negatively influence FCR. Nevertheless, these results remain lower than those reported in previous studies: 1.90 to 2.30 (Zongo, 2016), 2.1 to 2.2 (Ouedraogo, 2017) and 2.5 to 2.72 (Sanni, 2014) in 35 days. The results obtained in this study were closed to those of Ciewe (2006) (1.86 to 1.96), Ntivuguruzwa (2008) (1.9 to 2). The production period was between October and December, which is a favorable time in tropical climate for raising broiler chickens. SANOFI (1996) noted that when the temperature is oscillating between 32 °C to 36 °C, there is a decrease in the food uptake by 4.2 g/adult subject/day. Alloui *et al.* (2001), observed that chickens are unable to withstand heat. Which was not the case in our case.

3. 4. 4. Profitability

Almost all producers sold chicken per head at a price comprised between 2,250 and 2,500 CFA. The few producers who sold chicken per kg of weight did it at 1,500 CFA/kg. Compared to the local chickens of 1.5 kg sold at 3000 FCFA each, we assumed that broiler could be a boon for the urban population. The balance sheet allowed us to know that broiler farming generates an interesting profit for farmers because it is positive on all farms. Also, the study revealed that the cost of production per head of broiler in small farms was higher than in large farms. The price of broiler, was inversely higher in large farms than in small farms. It appeared that the benefit of broilers correlated to the number of subjects. In fact, the greater the number of broilers at finishing, the greater the profit per chicken head. That implied that the farms having the highest number of broiler chickens for sale were the most profitable. These results are explained by the fact that all medications were conditioned at 500 and 1000 doses. In addition, for flocks of the same size, those with a number of rearing days of 42 days registered a higher profit per broiler than those with 35 days. These values can be explained by the fact that zootechnical performance such as FCR is higher in 35 days rearing farms than in 42 days rearing farms and mortality is insignificant in the two types of rearing. This observation confirmed that slight differences in the FCR may have an impact on the financial margin (AVIAGEN, 2012). In addition, Leclercq and Beaumont (2000) asserted that by limiting wastage, productivity was increased through improved performance and reduced production costs. Betene (2006) suggested that by playing on the chicken selling price, we could increase revenue. Lame, stunted and malformed individuals are reservoirs and developers of potentially pathogenic microbes to other chickens. They constituted no-economic values which reduce the profit of the batch. However, regardless of the number of days of rearing or the size of the farm, the profit recorded was between 474 and 822 FCFA per broiler. These results are similar to those of Kabore (2017) who found 428 to 849 FCFA per broiler and superior to those of Ouedraogo (2017) and Zongo (2016) who recorded respectively 281 to 484 FCFA and 571 to 759 FCFA per subject. These high benefits are due to the rearing period which is the most comfortable for raising broilers. During that period, the heat induced mortality is lower and also the zootechnical performance such as FCR and ALW are good. This observation comforted Betene (2006) who found that the cost of poultry production increases with temperature.

IV. CONCLUSION

The aim of this work was to find the optimal broiler flock size to raise and the optimal number of days of rearing being economically profitable for farmer in Bobo-Dioulasso. A minimum of 1000 broilers per batch of flock size allowed the highest profit for farmers in the suburban area of Bobo-Dioulasso and therefore should be recommended for extension purpose. Further training and improvement of farmer skill of raising broilers may trigger increased benefit and should investigated. Also, a close monitoring of farms during hot and rainy season could shade light on the profitability.

V. CONFLICT OF INTEREST

There is no conflict of interest reported by the authors. The work was conducted under their supervision and each contributed to various aspects of the design, execution, writing, and review of the manuscript.

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