

Aviculture in the Hinterland of Lubumbashi City: Analysis of Technical and Economic Efficiency of the Local Chicken Production The Case of Kasangiri, Kawama and Mimbulu Villages

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Abstract: The breeding of local chickens is a better way of fighting against protein deficiency in Lubumbashi. Having a short cycle of production, the chicken breeding is a short term profitable activity because of it is low cost demand and can be exercised by all socio-professional categories. An analysis of traditional poultry practices was conducted among the 100 poultry producers in three villages, including Kasangiri, Kawama and Mimbulu in the Lubumbashi Hinterland; through which, local poultry farming has proven to be a technically and economically efficient activity due to the ratio of 7 and 3.5 respectively. A technical efficiency is mostly justified by the lower demanding nature of the activity and not by the use of zootechnical techniques by poultry farmers. The low score of economic efficiency is a consequence of lack of engineering techniques, infrastructures and many intrinsic and extrinsic factors.

Keywords: Poultry farming, Hinterland, Lubumbashi, Efficiency, Technical, Economic.

1. Introduction

The Democratic Republic of Congo has huge annual potentials for production of both market gardening and food crops (Vredeseilanden, 2004). The majority of the country's population would live on income derived directly from the agricultural sector (UNDP, 2009). However, about a decade ago, the food insecurity of the population in DR Congo may have reached an alarming level (Tollens, 2004; FAO, 2009). Despite the notable good assets in several areas of DR Congo agriculture; the crop production is still low, from production to marketing and the livestock production remains down due to many constraints affecting the development of the agricultural sector (Vredeseilanden, 2004). Hence over 70% of the population live in extreme poverty and some suffer from chronic malnutrition (UNDP, 2009). Moreover, the lower household income in both urban and rural areas (Mushagalusa et al, 2015) leads to severe food insecurity (Frederic et al, 2011). Indeed, the diversification of income sources would be a palliative measure to raise this low level of income which induces an unprecedented vulnerability in many agricultural households (UNDP, 2009).

As a source of animal protein for rural households, poultry farming can also be an alternative in increasing incomes in addition to rural activity (CTA, 2004). On the one hand, this activity occupies a considerable portion of the national economy but a much larger share of the rural economy (ISSA, 2012); where it remains one of the income providers and satisfaction activity to the household needs of actors. Emuron et al (2010) mentioned that, thanks to poultry farming, poor actors usually managed to cover their domestic needs, and this provides to the traditional poultry farming a valuable place among so many other global sectors where poultry is just coming after pork and beef, it being 85% of the world's chicken production (Alain, 2004). Traditional chickens account for about 80% of the total poultry population in Africa and contribute with a very

important proportion of meat production (25-70%) and eggs (12-36%) (Gueye, 1998). Family poultry is one of the survival means of households, integrating several activities that give it a certain connotation in the functional and operational system of the farmer, because besides the financial contribution role that it plays, it also assumes a sociocultural role. (FAO, 2004). Thus, the major importance of local chicken farming is no longer to be demonstrated on the socio-economic level, accounting the important role played by the latter in poultry farming of many developing countries (Moula et al, 2012). In addition to being a significant source of animal protein, the traditional poultry farming is a regenerative activity of income (Emuron et al 2010). In Burkina Faso for instance, every year, the consumption of chickens has consequently resulted to investment with billions of FCFA thus raising the rural economy without ignoring the export of other ovo-products to other surrounding countries, resulting to the significant increase of actors (SWAC, 2007).

Moreover, certain assets have contributed positively to poultry farming, such as: a short-cycle activity, a source of incomes to actors, job provider and conspicuously valuable nutritional quality with low investment costs (Missohou, 2008). On the other hand, family poultry, for many, has still remained a sector with low livestock productivity because of its poorly valued and sometimes fragile state (CTA, 2008). Although characterized by a low yield; traditional chicken rearing faces diseases that sometimes destroy the entire herd on some farms (Buldgen et al., 1992). At the upstream, it is necessary to recognize that the lack of use of current technologies and adequate knowledge on poultry farming principles (Missohou, 2008), are the main constraints of this activity; and downstream, epidermio-endemic pathologies are of a severe nature and constitute a crucial constraint in the development of the sector (CTA, 2004), thus causing many losses to be earned. The lack of veterinary assistance and the permanent wandering of the animals, make this breeding not only a prey to epizootics and diseases of all kinds, very devastating such as Newcastle (Gueye, 1998), and Gumboro continually causing material and financial losses (Missohou, 2008). However, the lack of biosecurity standards makes this sector a vector of diseases (Alders R, 2000).

As in the DR Congo (Min Agri, 2010); Due to rapid population growth in developing countries instead of economic development (Ndayisenga, 2010), the lack of infrastructure, commercial organizations and food resources are one of the factors slowing down the development of this type of livestock in Africa (Huart et al 2004). At the present time where certain political and climatic factors (disturbances) cause several adverse effects on human lives; even the assets relating to the means of population survival are permanently being deteriorated (FAO, 2014) although Congolese agriculture obviously has such a considerable potential for growth that it would be necessary to be considered in order to hope for a repair of damage. However, several indicators classify DR Congo in a state of chronic poverty; at 94.6%, the informal sector is the source of household income and survival (UNDP, 2009). The level of food insecurity and acute malnutrition mostly affect children or even older people, hence the current state of the Upper Katanga province would result from the country's position on the list of poor countries (FAO, 2014), putting its population at greater risk of mortality if no intervention planned. Moreover (MECNT and UNDP, 2013), the carbohydrates, lipids and proteins that can be provided by traditional poultry farming are substances that are particularly essential for the maintenance of the organism, which would allow the attenuation of the acute malnutrition rate among people of all ages in the households of Lubumbashi city hinterland (FAO, 2009).

Confronted this life headline situation of the Congolese population in general and in particular Lubumbashi population a scientific gaze must be put on this area, for the raising of local chickens provides profit in a short term and its production cycle requires a low production cost (Buza and Mwuamuhehe, 2001).

This study is providing information on local poultry farming, and sets as objective to analyze the technical and economic efficiency of traditional poultry farming by characterizing the poultry techniques applied in the villages, the hinterland of Lubumbashi city: Kasangiri, Kawama and Mimbulu. This study is based on the assumptions that (1) the consideration of poultry practice by households as a regenerative income activity may lead to the conclusion that this practice is economically efficient; (2) the poultry techniques and the educational level of the breeders in the field would be the factors determining the efficiency and the financial utility of the sector.

Therefore, to achieve the objectives of this study, a series of main operations was to be carried out: to determine the socio-economic status of poultry producing households, to evaluate the profitability and efficiency of poultry farming; finally, to identify the techniques and constraints that arise in poultry practice.

2. Study Area, Material and Methods

2.1. Study area

This study was conducted in the hinterland of Lubumbashi city, precisely in the village of Kasangiri, Kawama and Mimbulu; villages situated in the Kaponda community, Kipushi Territory in the province of Upper Katanga. Kawama is a part of the great Kinsevere site; located in the mining square of Lubumbashi about 27 km north-east of the city of Lubumbashi 1km north-east of the Kiswishi quarry along the Lubumbashi-Likasi National Road. The sector is at $27^{\circ} 32'$, $27^{\circ} 36'$ east longitude and $11^{\circ} 19'$, $11^{\circ} 24'$ south latitude. Although Kawama is partly extended in the Kinsevere project's site; agriculture is the main income provider activity to most of households though the soil nitrogen deficiency is very noticeable in this area and which would require a supply of mineral elements for the correction and improvement of agricultural yield (Mushagalusa et al, 2015). While Mimbulu is located at around 18 km from the city of Lubumbashi between $11^{\circ} 31'48.81''$ South and $27^{\circ} 36'36.84''$ east (Tshomba et al, 2013), along the Lubumbashi-Kipushi Road. Family farming remains the main household economic activity and a major source of income. Mimbulu greatly provides food (vegetables, sweet potato and corn) and other commodities (such as charcoal) to Lubumbashi city. The position of this village, located between Lubumbashi and the mining town of Kipushi, confers it an opportunity to play the role of agricultural development in order to respond to the unceasing demand of food in the urban areas.

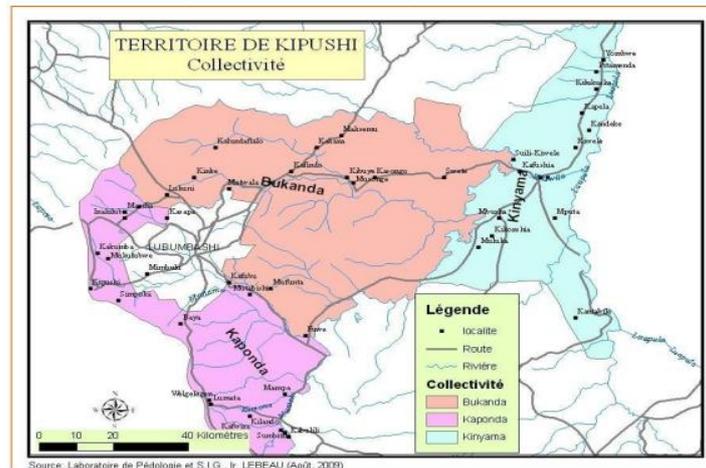


Figure 1: Kipushi collectivities covering the study area

2.2. Materials and methods

This study was carried out on a descriptive survey from April to July 2017, consisting of understanding the management of traditional poultry farming, the end of the products, the difficulties which can be faced when this activity is performed in order to evaluate the efficiency both technical and economic. About one hundred (100) producers of native hens were interviewed during the surveys, it being thirty individuals in Kasangiri village, thirty individuals in Kawama village and finally forty individuals in Mimbulu, fulfilling respectively the three Lubumbashi main axes of food supply (Kasenga, Likasi and Kipushi axe). The respondents were randomly met and interviewed just as they were found present at the time when the survey was conducted with a questionnaire. This questionnaire was composed on the one hand by the explained variables such as: activity main source of income, the aim of the poultry career, and on the other hand the explanatory variables such as: the kind of actor, the training level on the poultry domain, the size of the livestock, the seniority, the production environment, the conditions at the sale and the assessment of the activity costs and its contribution to the overall income of the producing household. A precision balance was used to collect the weights of cocks and hens sold by producers.

Efficiency analysis

The efficiency is an internal measure of company performance, it is very frequently valued in terms of production, profit or productivity costs, and measures the quantity of resources used to produce a unit of goods or services (Johnson and Scholes, 1997) cited by (Benzai, 2016); It is therefore the best use of the means. Therefore, an efficient appreciation implies a rational allocation of fewer resources, or simply the least cost

optimal production. Meaning that efficiency is the property of a system achieving optimal results with very low or reduced expenses (Gadedjisso, 2009). Then this concept puts a relationship between effectiveness and means used to obtain the results (Gonsard, 1999). When taking into account both results and expenditures, efficiency is therefore a more complex concept than effectiveness, which only takes into account the results (Gadedjisso, 2009). Moreover, the efficiency applies to factors of production and effectiveness is applied to the objectives (Stéphane, 2011). There are many forms of efficiency, but four of them are the most used (Berger & Bonaccorsi, 2006): technical efficiency, allocative or price efficiency, economic efficiency and scale efficiency. The aspects addressed in this study focused on the technical efficiency establishing the relationship between the real inputs (physical measurement of consumed resources) and economic efficiency; which simultaneously takes into account technical and allocative efficiency if they have an intersection (Berger & Mester 1997).

The determination of efficiency is generally carried out by several methods, the most common of which are the parametric and nonparametric methods. In view of available information of survey collected from producers in the hinterland of Lubumbashi, the non-parametric method is proved to be very objective. The efficiency is calculated by the ratio (outputs / inputs) according to Debreu (1951). And its threshold is defined by ($E \geq 1$) determined by Deprins *et al.* (1984) cited by Pierre Cariou *et al.* (2015). Hence, the variables needed to estimate economic efficiency are presented such as: inputs (capital invested, activity costs and livestock numbers at the start of the business) and outputs (production sold and actual livestock available). Then we have the formulas of technical efficiency (E_t) and economic (E_{eco})

$$E_t = \frac{\overline{X}_{\text{number of the current Livestock}}}{\overline{X}_{\text{number of the Livestock at the start}}}$$

with \overline{X} : the average

$$E_{eco} = \frac{\overline{X}_{\text{business income}}}{\overline{X}_{\text{(invested capital + of Costs)}}$$

Thus, the overall goal of the measure of relative efficiency is to identify two categories, depending on whether the efficiency score is equal to or greater than 1 (efficiency). Otherwise (less than 1) we will talk about inefficiency (Cariou *et al.*, 2015).

Data analysis was realized using IBM SPSS Statistics 21 software.

Results and discussion

1. Socio-economic status of producers

Fifty-eight percents of poultry producers interviewed among the 100 respondents were female, it being 29% of women producers for Kasangiri village; 18% and 11% of female poultry producers lived in Kawama and Mimbulu village respectively. As in Mali; it has been reported that 70% of rural households survive through poultry farming and women are the majority owners of poultry (Sow *et al.*, 2014). These observations corroborate those of Ndayisenga (2010) in the Saint Louis region of Senegal, and Mensah and *al.* (2011) in Benin; where this sector has remained a substantial help for women and children. This business is seen to be so important in the Lubumbashi hinterland given the high unemployment rate prevailing in the country and its cities, and much worse in rural areas (UNDP, 2015).

Ninety-one percents of producers were married adults with a mean age of 34 ± 9 years, and the poultry farming was considered as a secondary source of income by 96% respondents. Fabrice (2010) in Senegal underlined that this activity was performed by adults as a secondary activity after agriculture which is the main source of income. The same is shared by (Moula *et al.*, 2012) in a study on family poultry in Bas-Congo, showing that most of the local people are farmers than poultry farmers.

2. Overview on traditional poultry farms management

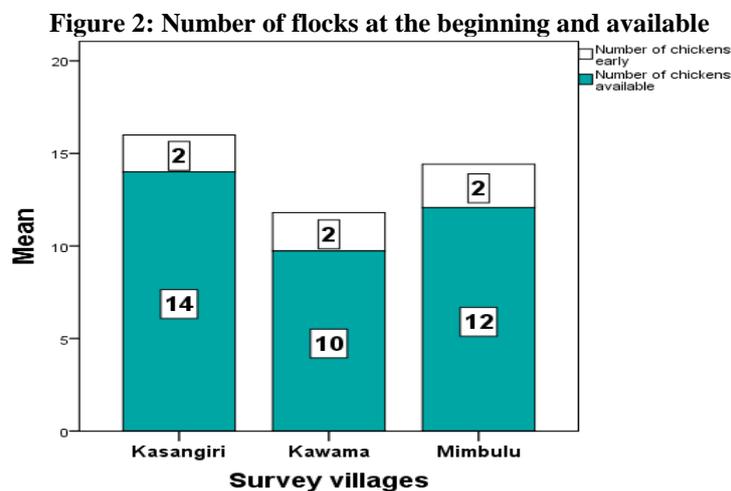
The breeding of native chickens is still traditional and very rudimentary. 3% of producers had a henhouse separately from their sleeping house. Then, 97% of poultry farmers raised poultry in their houses for lack of hen house. This proves that poultry breeders were unaware that the lack of hen houses would affect the growth of their poultry to the point of compromising reproduction. This situation becomes a characteristic of poultry farming in rural areas, as in Senegal, where chicken coops were almost non-existent (Traore, 2006).

Poultry diseases were registered at 80% of cases and diseases most frequently contracted had for treatment based on plants, meaning that the care was traditional (at 66%). The traditional treatment is proved to be uncertain, inadequate and having sometimes adverse impacts on poultry yield according to the result obtained by Missohou et al, 2002 in the Kolda region. There was no sanitary coverage yet one of the crucial aspects in poultry production (Konimba, 1997). The food monitoring was assured at only 2% with corn bran and small fry irregularly offered without any precision on the quantities consumed. Thus, the lack of food care and non-water intake affects negatively the resistance of birds to pests and diseases, then the mortality of the flock increases (Jens et al, 2004), while egg production and bird growth will be limited depending on access to food and their genetic potential. The major characteristic of this breeding is the fact that poultry must ramble in search of their own food, although the supplement is provided by the farmer (FAO, 2004). The lack of follow-up and the inattention to chickens, otherwise the abandoned poultry leaved in a total freedom and a diet scarcely adjusted to the needs of birds result to a considerable loss of productivity (Jens et al, 2004).

3. Livestock evolution

The majority of poultry producers (92%) work partially on this business. This shows why the commercial outlook on local chicken farming is still recent and their involvement in control of production is still not significant. In addition, poultry farming being not well planned the destocking takes place according to punctual economic needs of households (marketing or barter) and social needs (donations or sacrifices) (Mbao, 1994, Ali, 2001, Alders, 2005). This aspect of matter would make the description of herd movement difficult in a farm where only bloodstocks and preferred layers can last for a year or more in the barnyard.

Native hens were the poor good layers with 8 ± 2 hatching chicks and 6 ± 3 on average weaning chicks. Poultry rarely manages to wean more than 6 chicks because of the high mortality rate of chicks. This is justified by the low hatching rate caused by the poor nesting conditions, which are sometimes located in places that are warmer like the kitchen or wetter during the rainy season. These conditions are proven to be disadvantageous for poultry production in the Saint Louis region of Senegal (Ndayisenga, 2010). Sometimes the lack of nests causes the hens to lay their eggs on the ground, incubate and raise their chicks; but the long incubation periods adversely affect egg production (Jens et al, 2004).



Source: Surveys of 2017

The figure 2 reveals, on average, the evolutionary scale of the herds according to the three studied villages. The overall average number of chickens ranged from 2 to 12 in period of about 6 years of poultry production. There were no significant differences between the villages, as since rearing conditions and the resources allocated to them remained the same. Poultry numbers on a family farm in Mali were around a few dozen chickens (Sow et al, 2014). In fact, poultry populations per household are estimated at 10 chickens in the Thiès and Fatick regions (Buldgen et al, 1992); 5.2 ± 4 in the Kolda region (LY et al., 1999) and 10 to 14 in the peri-urban area of Dakar (Mandiamy, 2002).

It was observed that two producers in Kasangiri in addition to a breeder in Kawama had a herd of about 50 chickens constituting the maximum volume. Analysis of the information collected during the surveys in the three villages showed that, for 100 producers interviewed; the poultry population at the beginning of poultry was 216 chickens and the standing poultry population available from producers met was estimated at 1195 birds after about 5.3 years; 40% of poultry producers were from Kasangiri village. The low level of livestock productivity in rural areas is justified by insufficient zootechnical and poultry knowledge on the one hand and awkward infrastructure and technology on the other (CTA, 2008).

Table 1: Number of brood-weaned chicks and the poultry population according to surveyed villages

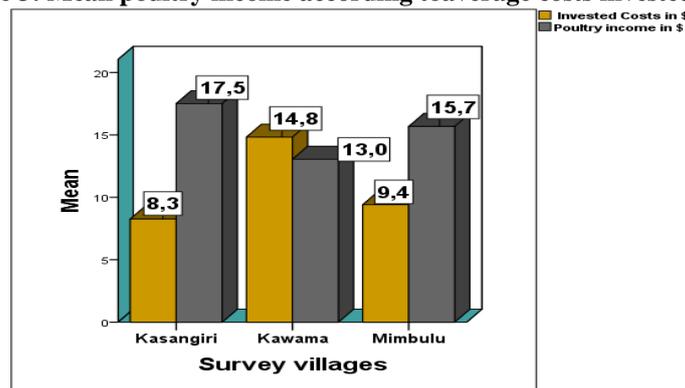
Villages	Brood chicks	Weaned chicks	Early Livestock	Available Livestock	Mortality rate(%)
Mimbulu	317	259	94	483	18,2
Kasangiri	287	210	60	420	26,8
Kawama	251	167	62	292	33,4
total	855	636	216	1195	

Source: Surveys of 2017

4. Economic situation

Economically 59% of poultry production was for sale and 41% for self-consumption of the producing households. In Mauritania, the sale of a chicken provided satisfaction for small urgent needs (care, food) in addition to the social role (Mokhtar, 2009); hence the poultry constitutes the piggy bank of households. The financial investment in this sector ranged from \$ 1 to \$ 42, with an average of 9.1 ± 10 \$ against an estimated poultry income of 15.4 ± 6.2 \$, although poultry farming is considered a secondary household income. Generating income has long been the first goal of family breeding, although the income from family breeding may be little (FAO, 2004). The economic situation of poultry farming does not differ from a current account, easily mobilized at any time to meet urgent and punctual family needs (purchase of relish, school stationery, participation in family ceremonies, contribution ...). Then there are donations (to visiting relatives and friends) and ritual sacrifices, especially the healers' indications for treating certain diseases. This information on the socio-economic usefulness of poultry has been mentioned by other authors such as Gueye (2002) in Burkina Faso and Traore et al (2006) in Senegal.

Figure 3: Mean poultry income according to average costs invested by site



Source: Surveys of 2017

Poultry farming is proved to be a profitable activity at a rate of around 65%. Mokhtar (2009) describes traditional poultry farming as not only a promising and important but as a largely profitable practice because of its low dependency on imported inputs, in addition to its contribution to food security and reducing poverty to actors.

Table 2: Weight of chickens sold by village

Weight on sale (g)		Survey villages			total
		Kasangiri	Kawama	Mimbulu	
Hen	Mean ±	1803±342	1800±351	1992±448	1878±398
	Minimum	1500	1500	1500	1500
	Maximum	2810	2900	2818	2900
Rooster	Mean ±	1298±67	1202±124	1313±83	1275±104
	Minimum	1180	1030	1180	1030
	Maximum	1455	1440	1500	1500

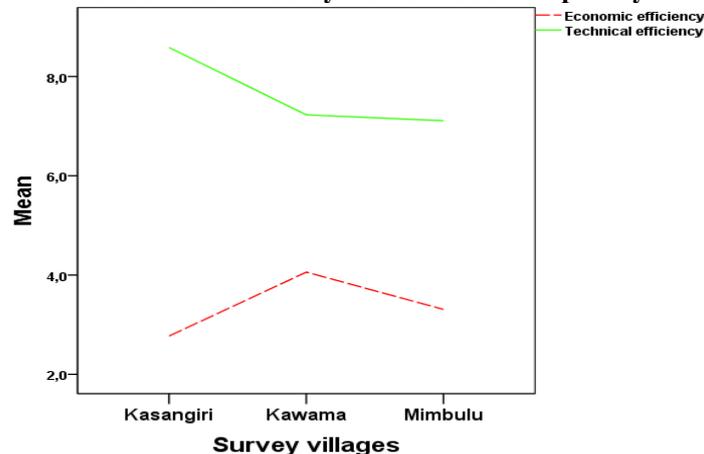
Source: 2017 Surveys

The table 2 indicates that the mean weight of chickens varied according to their sex (cock or hen). The mean weight of a rooster on sale was 1.878 ± 0.398 kg, while that of the hen was 1.275 ± 0.104 kg with the mean age estimated at 10.2 ± 3.9 months. Jens (2004) showed that a local hen weighs no more than 1.2 to 1.5 kg at the time of laying, and a rooster weighs 1.4 to 2.0 kg at the age of maturity. There was a difference of price between the roosters and the hens. In fact, the rooster was sold on average at 5.24 ± 0.77 US \$; while the hen cost on average 3.30 ± 0.46 US \$ with as extreme 3 US \$ and 7 \$ (for rooster), 2 US \$ and 5 US \$ for the hen. These differences were justified by the weight of the chicken on sale. Generally, traditional chickens are usually sold alive (Emuron et al, 2010). In Mauritania, the price of a chicken weighing 1.2kg varied from US \$ 2.5 to US \$ 6.8 (Mokhtar, 2009); whereas, the volume of chickens sold daily was on average 2 ± 1 with a maximum of 5 chickens. In Dakar, for instance, (Mbouga, 2011) the number of chickens sold daily is considerably larger than the one mentioned here. As we pointed out above; the commercial aim being recent in these areas, makes even the poultry farming to stay poorly developed. However, raising the level of poultry consumption in general implies to consider actions focused more on some aspects such as; beliefs, religious and festive manifestations, eating habits and income levels as determining factors (ISSA et al, 2012).

5. Economic and technical efficiency

The economic efficiency of poultry farming was low than the technical efficiency, with an average ratio of 3.4 ± 1.9 against 7.1 ± 6 respectively. Considering the gender of producers, women compared to men were economically and technically efficient at 4 and 7.7 against 2.9 and 6.2 respectively. The production techniques are poorly known, the control of poultry trade not well assured (such as the fixing of price and the number of products sold on a given time), in addition to this, there is the fact that poultry is taken as a secondary business and its low revenue. This poultry activity was assessed at a threshold of 1 according to the theory stated by Deprins *et al.*, (1984) and that the technical efficiency is included in the economic efficiency (Berger and Mester, 1997). Then the activity was efficient. Gilbert (1980), illustrated that the efficiency is part of the company performance; however the poultry performance requires to take in account the aspects showed by Konimba (1997), and the better understanding of the marketing techniques.

Figure 4: Economic and technical efficiency view of traditional poultry farming by village



Source: Surveys of 2017

The above graph illustrates that the ratio between the current herd population and herd population at the start gave a positive quotient (technical efficiency), compared to the quotient of the ratio of Outputs to Inputs (economic efficiency). The green line shows that Kasangiri village was technically very efficient (8.5) than Kawama and Mimbulu villages with a score of 7.2 and 7.1 respectively. However, the line in red indicates that poultry farming was economically very efficient in Kawama whose quotient value was 4.1, followed by Mimbulu and Kasangiri, whose coefficients of efficiency (3.3) and (2.7).

Poultry farming contribution to the income

For poor households, on average the total income was estimated at 127.9 ± 75.4 \$ per month, of which nearly 14% of this income would come from poultry production. In Dominican Republic 23% of household income would come from family poultry (FAO, 2004); however, in Niger, poultry farming has an average contribution of 15% to household income, ensuring 25% of producers' food needs (Abdouet al, 2016). In spite of all this, the economic standing of households was similarly acceptable for 27% of producers, whereas 73% of poultry actors were economically poor.

Table 3: Global incomes and mean poultry income of producers by Village

Villages	Average total income \pm (US \$)	Average poultry income \pm (US \$)	Poultry contribution to overall income (%)
Kasangiri	134,5 \pm 70,9	17,5 \pm 4,2	15
Kawama	123,4 \pm 95,3	13 \pm 6,4	13
Mimbulu	121,9 \pm 62,4	15,6 \pm 7	14
total	127,9 \pm 75,4	15,4 \pm 6,2	14

Source : Surveys of 2017

6. Constraints

Poultry production was seriously constrained to multiple situations such as; theft (37%); diseases (24%); mortality (20%); predators attacks (14%) without ignoring the bad weather. To overcome these constraints, producers should think to get subsidy (69%); training in poultry farming (23%) and poultry house construction (8%). The major constraints of local poultry farming are more related to food, the health of birds, and the lack of management concept but even more the lack of mastery of technical standards (Abdouet al, 2016). What is obvious is that diseases are common and affect birds at different stages of growth, but the most preventative method is the careful maintenance which would limit disease damage in chicks (Jens *et al*, 2004).

Conclusion

Poultry farming is one of the sectors with low investment which is available to all, but most important to a rural household. Poultry production in the majority of rural households elsewhere and those particularly in the Lubumbashi Hinterland (Kasangiri, Kawama and Mimbulu) is a second source income after agriculture at 96%, and then women involvement in this activity was at 58% of whom 28% resided in Kasangiri against 42% of male producers. The usefulness of the activity is well perceived by married adults (91%) having 34 years old for a poultry production intended for marketing at 59%. In the rural world, it is normal that everything is routine, in general the breeding of native chickens has kept its traditional and rudimentary state; 97% of farmers raised birds in their homes without and missed a henhouse; the lack of adequate infrastructure was justified by the food independence of chickens who want to feed themselves (98% of cases). Frequent cases of diseases (66%) are traditionally treated with plants.

Poultry farming is part-time for 92% of producers. Low reproduction of chickens due to a technical deficiency, 6 chicks weaned on 8 broods clearly indicates a significant mortality rate. From two chickens at the beginning of production, the number of herds varies from 12 to about 50 birds in about 7 years. During surveys, a total of 1195 live chickens were numbered, it being 483 in Mimbulu; 420 and 292 chickens respectively in Kasangiri and Kawama.

With an average investment of about US \$ 10; the sale of a 1.87 kg cock is estimated at 5.2 US \$; while a hen of 1.2kg was sold at 3.3 US \$. For 127.9 US \$ of total household income, poultry production would provide 14% of total income. This explains a low economic efficiency of poultry farming (3.4) and a technical efficiency of 7.1, although the presence of various constraints such as theft, diseases, mortality, lack of good infrastructure and both economic and zootechnical concepts which affect negatively the activity.

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