

Full Length Research Paper

Characterization of layer poultry production in Rwanda

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Improved poultry production systems in Rwanda are recent, uncharacterized and not documented. This study was to establish current status, identify the challenges and recommend improvements to layer production systems in Rwanda. The study was conducted on 172 layer poultry farmers from all the four provinces and Kigali city using questionnaires. The majority of farmers kept Rhode Island Red (RIR) 76% and chicks were mainly (73%) imported from abroad. Permanent poultry premises were commonly present (63%) and majority of them (91.9%) were correctly oriented however, lacked proper ventilation and Stocking levels were generally very low as the majority of farmers 75% kept less than 1000 birds. The deep litter system using saw dust predominated (91.5%). Majority of farmers (92.5%) practiced on- farm feed mixing and birds were always fed manually, and those below four weeks were generally underfed. The duration of lighting in poultry pens was within the recommended ranges. Diarrhea was mostly reported (61%) followed by skin diseases (15%), flu (12%) and paralysis (12%) as the commonest diseases. The production parameters with regard to growth and survival traits were inferior to international standards. Lack of quality feeds (38%), credit (20%) and poor market accessibility (19%) were the main challenges reported.

Key words: Layers, egg production, efficiency, challenges, Rwanda.

INTRODUCTION

Rwanda, locked in East Africa, has evolved through a period of economic prosperity and macroeconomic stability in the past two decades. Its efforts to achieve economic transformation are beginning to bear fruit, and the development of value chains provides strong potential to consolidate the current gains (ADB, 2014). Prospects for further development of value chains exist in several cluster areas, including non-ruminant animal production. The poultry sector of Rwanda is one of the cluster areas for value chain development. Poultry are the most predominant in terms of numbers with an estimated population of 4.8 million birds (FAOSTAT, 2014). Over 80% of the small-scale farmers in Rwanda rear chicken,

majority of which are indigenous (FAO, 2009; NISR, 2011).

In order to further alleviate poverty and insure food security in the long run, the efficient use of the available land through poultry and small livestock production could be one of the options for emphasis. Poultry production makes a disproportionately high contribution to the income and welfare of the poorest smallholders poultry farmers, and particularly of women, and through them, children in such households (Guèye, 2000). In that regard, the government of Rwanda has propounded a deliberate policy to increase animal proteins production through encouragement of pig, poultry and other small animal production (*MINAGRI 2012_a*). According to (Edward *et.al* 2010), augmenting the production of laying chickens is an important objective in helping to meet the nutritional needs of growing populations in developing countries.

These chicken are prolific, easy to raise and their output can be generally expanded more rapidly and easily than that of other livestock.

Furthermore, they are adaptable to various climates and altitudes. Poultry raising can often be combined with other types of farming and offers the possibility to raise extra revenue for farmers. The land and capital requirements to start a small enterprise are not great, yet farmers who market eggs on a regular basis have a valuable source of ready cash.

Commercial Layer hen enterprises are mainly characterised by confinement facilities, artificial lighting and ventilation, a large number of highly productive hybrid laying hens kept mostly in battery cages/deep litter that provide a limited amount of space, use of complete feeds (that may contain antibiotics, stimulants, hormones, artificial colourants, etc.), use of many farm hygiene and maintenance products. This type of production provides a ready supply of eggs for consumers throughout the year in large amounts and at a relatively low price (Pavlovski et al., 2010).

However such systems suffer from low profitability or losses in many of developing countries all over the world (Edward et.al 2010). Typically, a layer's production cycle lasts just over a year (52-56 weeks). During the production cycle many factors influence egg production. Therefore, the cycle must be managed effectively and efficiently in order to provide maximum output and profitability. Factors influencing profitability of layer poultry production in developing countries have been recently analyzed in Jordan (Ebrahim et.al 2012). It was found that high feed prices, higher prices of breeding pullet, cost of labor, cost of veterinary service and medicine were the main factors. Among other factors, the breed of the laying bird also influences egg production. Management and feeding practices, however, are the key determining features for egg production (Edward et al 2010).

The systems used for egg production has a large influence on the above factors and hence on profitability. Over the last few decades, new laying hen rearing systems have been rapidly introduced into poultry production in an effort to harmonise poultry health and welfare with consumer, producer, industry and environmental demands (RAKONJAC et al, 2014).

Certain countries already obtain a significant percentage of eggs from alternative rearing systems. For instance, in Switzerland, as much as 80% of laying hen flocks have access to free range (RAKONJAC et al, 2014)

A recent study in Rwanda (MINAGRI, 2012 found out that there was great potential for improved poultry production for the local market and possible export to the accessible markets of democratic republic of Congo, Burundi and Congo Brazzaville. However a number of constraints have to be addressed. Emergence of major poultry business farmers (breeders, and commercial rearing of layer and broiler poultry) for promotion of

poultry products were identified as some of the major strategies for improving the poultry industry in Rwanda. Whereas the MINAGRI 2012) study dwelt on value chains emphasizing marketing, processing and price, it ran short of assessing the production practices of emerging layer and broiler farmers. The characteristics and production performance of poultry production systems can vary according to different physical, environmental, technical and socioeconomic factors that mitigate against optimum production. (Edward et al 2010). There is therefore a need to assess and understand improved poultry production systems in Rwanda. This will enable the development of specific policies, strategies and activities for improving poultry production.

The main objective of this study therefore, was to assess the current status of commercial layer poultry production, determine the challenges and make recommendations for improvement.

METHODOLOGY

The study was done in the 4 provinces of Rwanda (eastern, northern, southern and western) in addition to Kigali city in the period of 3 months. The 172 respondents were chosen through a multistage sampling procedure at province, district and sector levels. Due to time, financial resources and availability of technical staffs, the sampling rates at different stage were that all provinces were surveyed and 50% of district were selected from each province except in Kigali city where all the district were selected. Within the selected district 10% of the sectors were selected except in Kigali city where 3 sectors were selected (table1).

The ultimate sample size was determined using Slovin's formula (Cochran, 1963). Which was applied on the nation chicken population as follows:

$$n' = \frac{N}{1 + N(e)^2} \times \text{Design effect}$$

$$n = n' + 5\%n'$$

N = 845,179
 e = 5% (level of significance)
 Design effect = 2

Accordingly a simple size of 252 layer poultry keeping households from 48 sectors was determined but 172 layer poultry farmers were finally surveyed. A pretested semi-structured questionnaire was used by pre-trained academic staff to gather the necessary data from identified layer poultry farmers. The data were entered in the computer using the software SPSS16.0 and analysed using the same software in addition to the Microsoft package Excel 2007 to generate information in form of means, percentages, ranges, etc... Presented in tables, text, graphs and charts.

Table 1. Selected district and sectors in the study areas.

Province	Total Districts	Selected Districts (50%)	Total Sectors	Selected Sectors 10%
EAST	7	3.5 ≈ 4	95	10
WEST	7	3.5 ≈ 4	96	10
NORTH	5	2.5 ≈ 3	89	9
SOUTH	8	4	101	10
KIGALI CITY	3	3 (100%)	35	9

RESULTS AND DISCUSSION

1. Social economic characteristics

A total of 172 were surveyed. Most of the farms 43% were located in peri-urban areas, 33% were from urban centres and 25% were from rural areas. These results show that layer poultry production is relatively well distributed in rural, urban and peri-urban areas. This implies that improvement in layer poultry production is likely to benefit rural, as well as urban and peri-urban dwellers.

Most of layer poultry farmers (51%) travelled less than 2km to reach the main/feeder road. Only 30.2% of respondent farms were more than 5 km from the feeder road. This is favourable for marketing and accessing inputs. With regard to gender (table 2) the majority of the respondents (68%) were males whereas 32% were females. Southern province had the highest proportion (25%) followed by eastern 24% and Kigali city had the least proportion (11%) of female respondents. This could suggest that the females in southern and eastern provinces were more involved in layer poultry farming as a business or they lacked alternative enterprises for a livelihood.

The average age of respondents was 38.4±11.5 years ranging from 16-86 years which is in line with the fact that 39% of Rwandese are in their youthful (14-35) age range (ECIV 4, 2016). It also suggests that the youth are likely to benefit from any improvements in layer poultry production as only 11.7% of the respondents were more than 50 years of age.

Majority of respondents 46.8 % had attended primary school followed by 34.5% who had attended secondary school and only 12.9% had attended university education. This low level of education among the respondents could be attributed to low financial returns from poultry farming to support highly qualified labour and also to the fact that the majority of Rwandese (78.6%) have primary level of education (NISR, 2012).

The majority (72%) of respondent were family members with husbands 42.1% predominating followed by children 28% and spouses 24% while employees were 28%.

This results resemble those reported in Oyo state, Nigeria (Adisa and Akinkunmi 2012) where it was concluded that the extent of participation of women in

commercial poultry activities in the study area was low. However, the results are different from those of a study on gender issues in poultry production in rural households in western Kenya (Okitoi et al, 2007) which showed that ownership of rural poultry is shared among the family members but is predominantly by women (63%) and children (18%).

2. Layer poultry Housing

Permanent poultry premises were common as 63% of layer poultry farmers had constructed permanent structures (concrete floor, burnt brick walls and iron sheet roofing). It was also noted that most of the poultry houses 91.9% were correctly oriented in the East-West direction and the distance was always less than 100m from homestead. Most farmers however, were not well conversant with the required levels of ventilation in poultry houses as only 5.4% had poultry houses with the recommended ventilation levels((Edward *et.al* 2010) of over 40% of the wall area.

Whereas poultry welfare considerations are very important in poultry housing (Lay 2015). The cost and depreciation of the houses are likely to influence the profitability of enterprises (Ebrahim *et.al* 2012). Therefore small scale layer poultry farmers like those in Rwanda should also consider the option of layering their birds outdoors.

3. Production Systems

In this study, an over whelming majority (91.5%) of respondents used the deeplitter system and saw dust was solely used as the litter material and the other few used battery cages.

There is increasing discussion and research (Khaled *et.al* 2012), (American Veterinary Medical Association 2011; Lay et al. 2011) on the merits and demerits of indoor production system as opposed to free ranging, on the basis of poultry welfare, cost of feed, quality of eggs and profitability. Free-range system is likely to improve the laying hen nutrition through obtaining various feed items from the outdoor run, such as grass, insects, earthworms, and grit stones. That could reduce the feed cost and sustain egg production (Mattocks 2002; Anand et al. 2008; Blair 2008; Lay et al. 2011). It allows poultry to

Table 2. Percentage distribution of gender of respondents by province.

Provinces	Male	Female	Total
Kigali city	13	11	24
Eastern	26	24	50
Western	24	20	44
Southern	17	25	43
Northern	20	20	40
	100	100	200

perform a natural behavior and provides sunlight, fresh air, and access to ample space, which can support better health and low-stress environment.

Despite the wide increase in the use of the outdoor poultry production systems, studies with different managerial conditions and various climatic zones, particularly in the tropics to avoid production seasonality, still remain to be done (Lay et al. 2011; Mench et al. 2011).

In a recent study conducted in Mexico, (Khaled *et al* 2012) the suitability of out door scavenging system for Rhode Island red hens under tropical conditions was assessed and it was concluded that the outdoor system in the tropics had beneficial effects on the Rhode Island Red hen performance and hens utilized the outdoor area effectively and obtained various feed items.

However more recent review on laying hen rearing systems concluded that, none of the rearing systems can be regarded as superior, since each has both advantages and disadvantages. Future research should focus on different genotypes reared under certain climates and environments in search of the most suitable genotypes for a particular production region. Furthermore, organic production would benefit from future studies regarding improvements in performance and product quality. Therefore, specific importance should be given to nutrition-related issues, such as different diet formulations and quality of the outdoor range, as well as issues regarding the cost efficiency of this production. Accordingly, optimum length of exploitation of different genotypes under this system would be a particularly interesting research topic (RAKONJAC *et al*, 2014).

Therefore it seems logical to recommend outdoor rearing of exotic poultry genotype such as Rhode Island Red by Rwandan commercial poultry farmers.

4. Stocking rate in layer poultry pens

The average area for brooding chicks & growers in poultry pens exceeded the recommended space allocation (table 3) Gietema (2005). Such excessive space allowance per bird may be wasteful and counterproductive as birds spend more energy

meandering and there is loss of efficiency due to space underutilization

5. Lighting period in poultry (houses)

The reported duration of lighting for the different age groups of layer birds was within the recommended ranges (table 4) (Bart Gietema 2005).

Neglect for strict observation of recommended period of light for layer poultry leads to low performance which is common in Rwanda. According to Edward *et al* (2010), in closed houses, where layers are not exposed to natural light, and the length of the artificial day should be increased either in one step, or in a number of steps until the artificial day reaches 16 to 17 hours, which will ensure constant and maximized egg production. Effective day length should never decrease during the laying period.

6. Poultry breeding

The majority of layer poultry farmers (76%) kept Rhode Island Red followed by ISA brown (54%) and white leghorn (11%). The results however show that availability and price of day old chicks were also important factors determining the type of bird kept in addition to egg laying potential and tolerance to environment condition. Most farmers 69% imported day old chicks from outside the country, mainly Uganda and Belgium followed by sourcing from Private Rwandan hatcheries 31%. This could indicate the lack of good and advanced hatcheries in Rwanda to produce good rearing stock of layer birds. Such practice is not sustainable as it involves use of foreign currency and besides is often accompanied by high chick mortality which could be avoidable by sourcing from nearby.

According to Fassill (2010), Rhode Island Red is a good choice for the small flock owner. Relatively hardy and is probably the best egg layer of the dual purpose breeds. Reds persevere marginal diets and poor housing conditions better than other breeds and still continue to produce eggs. It is for this unique characteristics that Rhode Island has been year marked for cross breeding

Table3. space allocation (M²) in layer poultry houses.

Parameter	N	Mean(M ²)	Std. deviation(M ²)	Recommended area (M ²) (Gietema 2005).
Available area at brooding	172	0.082	0.0142	0.02
Available area at Grower stage	172	0.179	0.019	0.1

programs of indigenous chicken in Ethiopia to develop high performing synthetic lines. Recent studies, in northern Ethiopia (Abraham Lemlem and Yayneshet Tesfay, 2010) concluded that Rhode Island Red and white leghorn can be effectively managed for egg production under scavenging condition by smallholder farmers.

7. Flock size

The number of layer birds per farm ranged between 8-19000 birds. However most of the farms had very small flock size as 28.4% had less than 100 birds and 75% of farmers had less than 1000 birds.

These results resemble the situation reported in a recent study (Yemane *et.al* 2016) on small scale intensive poultry farms in Ethiopia. Poultry flock size per farm ranged from as little as 56 layers to a maximum of 415 layers with a mean of 141.6 layers.

8. Keeping of farm records

Record keeping is gaining ground as 83% of farmers reported keeping records especially those of feed usage. Records were most reportedly kept in farm record books (56.8%), soft copy's (17%) and the rest recoded on loose papers, wall and memory.

9. Feedstuffs and Feeds

The majority of respondents (92.5%) reported that they missed their own feeds at farm level and they reported a variety of basal feedstuff and sources of crude protein. This result could imply that farmers were well aware of the various available feedstuff that can be included in poultry ration formulations. It is not worthy that to meet the protein requirements in layer poultry birds, some farmers reported (table 5) incorporating forage of tree legumes-shrub in rations formulated at farm level.

It is notable that most of the feedstuffs such as cotton seed cake, fish meal, lake shells and others are imported since the raw materials are not produced in Rwanda or are produced in very small quantities. Over dependence on importation of feedstuffs is likely to greatly increase the cost of the final feeding rations and thus the need for encouraging the use locally available possible substitute

of the imported feedstuffs. For example, leguminous tree forage can substitute imported cotton seed cake.

In this study layer poultry farmers (table 6) reported to have started on the path of using leguminous forage and weed shrubs as feedstuffs. Such farmers need relevant advice from researchers and extension officers about the inclusion rate of forage substitute since some of them may be containing high levels of crude fiber and tannins. For example, in a feeding trial on layer chicken in Zimbabwe (Odunsi *et.al* 2002) it was found that inclusion of Glicilidia dried Leaf Meal in the layers diet beyond 5% reduced feed intake and beyond 10 and 15% reduced body weight and egg production.

In Rwanda there is growing competition between livestock and humans for maize and its by-products. However the maize yield per hectare is too low to meet the needs of the ever growing human and livestock population. This situation is enough to justify the exploration of the usefulness of other carbohydrate-rich feedstuffs as maize replacers in feed formulations as was the situation in Asian and Pacific region (Ravindran" and Blair, 1991). The possible maize replacers included cereal and by product, roots and tubers, fruits and by product etc.

In most developing countries like Rwanda the most commonly used protein sources for animal nutrition are by products of oil seed and fish meal, all of which are very expensive and scarce thus the need for exploring possible replacers.

10 the feeding practices (Amounts fed and frequency of feeding) were out of range of the recommended (Gietema 2005), practices for different layer poultry age group.

11. Methods of feeding and providing water

The majority of respondents (92.4%) practiced manual feeding and 68% practiced manual watering of birds. This could be attributed to the high cost of automatic and Semi-automatic feeders and waterers. The young birds below four weeks were generally underfed (table 7) whereas those between 4-16 weeks were generally over fed. Such feeding patterns are likely to be contour-productive as under feeding at early stages may cause stunting and high chick mortalities which may not be compensated by over feeding at late stages.

Table 4. The length (hrs) of lighting provided on layer poultry farms as compared to expected standards (Gietema 2005).

	N	Mean	Std. Deviation	Recommended Time (Gietema 2005)
Time of lighting doc-4weeks	168	17.24	7.6	24-16
Time of lighting for 4-16weeks	168	14.13	7.06	16-14
Time of lighting for 16-20weeks (pol)	168	13.76	6.85	14
Time of lighting for 20-96weeks (pod)	168	13.99	6.37	14

Table 5. Percentage of layer poultry farmers reporting use of different feedstuffs.

Maize bran	Wheat bran	Rice bran	Soya bean	Cotton seed cake	Fish meal	Born meal	Lake shell	Sorghum	Peas	Blood meal
90.7	14.6	37.6	76.4	75.5%	76.4	62	75.8	8.4	8.4	8

Table 6. Proportion (%) of layer poultry farmers reporting use forage of tree legume -shrub.

Rumari	Alfa- alfa	Leuceana spp	Wandringa	Moringa	Calandra
50	12	9.6	9	6.7	4.5

Table 7. Daily quantity of feeds (gs) provided per birds at each growth stage in layer poultry as compared to expected standards (Gietema 2005).

	N	Mean	Std. Deviation	Expected standard
Quantity of feed supplied/day/Chick to DOC-4weeks(g)	172	23.56	23.13	44
Quantity of feed supplied/day/Chick at 4-16weeks(g)	172	91.59	50.26	65
Frequency of feed supplied/day to DOC-4weeks	172	2.53	0.77	Ad.lib
Frequency of feed supplied/day at 4-16weeks	172	2.27	0.61	2

***Gietema 2005**

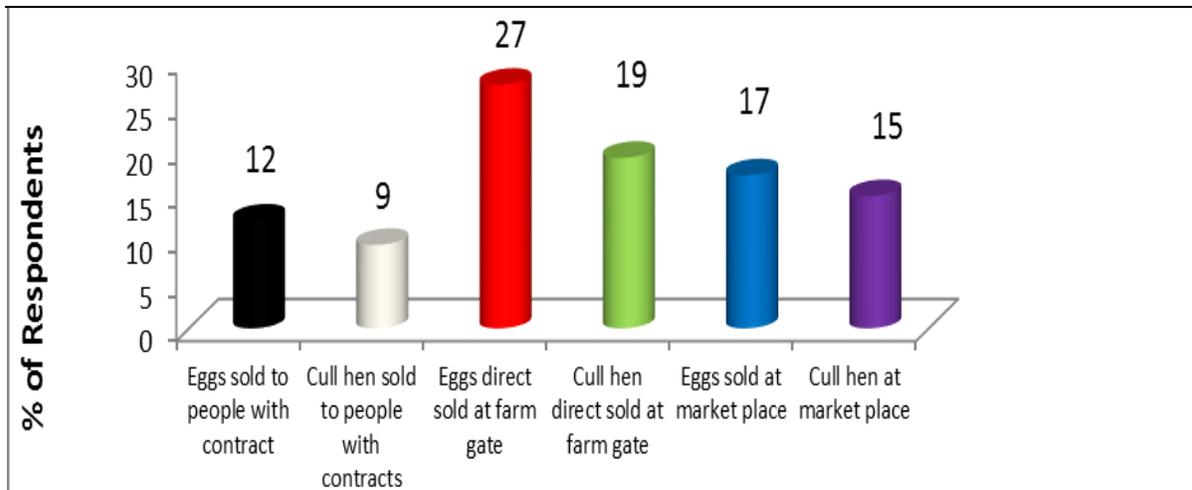
12. Health management on layer poultry farms

Whereas the recommended deworming frequency is once in the first three months, majority of the respondents (67%) dewormed every month. This could be a coping strategy to high worm challenge. The results revealed that bio-security measures most of respondents had taken a step as 49% of the respondents had footbaths at

the entrance of their chicken houses. However it was observed that those who had footbaths were not adequately using them. Almost all the respondents (98%) vaccinated their birds against the major poultry diseases, namely Newcastle and Gumboro. However, some diseases such fowl cholera were often left out, and recommended vaccination regimes were not respected. This may result into disease outbreaks leading to high

Table 8. Production parameters of layer poultry on surveyed farms.

Parameter	Results	Recommendation (Jull,1988)
Percentage of growers (post-brooding)	90%	95%
Percentage of birds reaching Point Of Lay	90%	95%
Mortality during laying	2.5%	1%
Laying percentage since Point Of Lay	76%	80-100%

**Figure 1.** Percentage distribution (%) of modes of saling eggs and culled layer hens.

mortality rates. No wonder, Diarrhea was reported (61%) to be the most prevalent disease condition experienced. This may be as a result of poor hygiene, failure to respect vaccination and deworming protocols. Paralysis and flu which are common manifestations of nutritional disorders and viral infections were also reported by 12% of respondents.

13. Production Parameters layer

The overall performance on layer poultry farms was below the expected performance standards by (Jull,1988) with regard to survivability and laying percentage (table 8).

These results indicate low levels of management leading to high mortality rates of chicks and also low rate of egg laying.

14. Culling and Layer marketing

Culled hen and eggs were the marketable items and they were sold in many modes (figure 1). Direct sale at farm gate was the commonest mode reported for both items. Only 18.6% of the respondents practiced fattening of off

layers at the end of the laying cycle to get better selling price.

Culling and marketing of unproductive birds is often recommended for profitability (Edward *et.al* 2010) as it enables a high level of egg production to be maintained and prevents feed waste on unproductive birds and may avert the spreading of diseases.

15. Challenges of layer poultry production

Layer poultry farmers reported Lack of quality feeds, credit and poor market accessibility as the key challenges cited. These may indicate poor service provision from private companies that supply feeds, credits etc. these results resemble those recently found in Ethiopia (Yemane *et.al* 2016) where The high price of feed, shortage of land, unavailability of pullets in time, high cost of pullets, feed quality and shortage of water were the major constraints in small scale intensive urban poultry production.

16. RECOMMENDATIONS

The entire poultry value chain of Rwanda require special attention in the areas of research extension and develop-

ments to propel it to international standards. Poultry farmers need training in all aspects of production and management such as feeding, breeding, housing, health and entrepreneurship. Special attention should be put on developing the national animal feeds industry using the supply chain approach. Alternative sources of poultry feedstuffs should be identified, evaluated and commercialized. Poultry farmers should also be encouraged to form production and marketing farmer groups or cooperatives. Adaptive research is required for testing and evaluating improved technologies from abroad to adapt them to the Rwandan situation. Effective linkages should be developed and strengthened between poultry producers and financial institutions to enable easy access to credit facilities.

As government funding is limited, poultry industries need to come forward either to establish their research facilities or to provide funds to universities and research institutes in order to undertake research works of national and international importance.

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