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Experimental Study of the Effects of Ergonomics on the Economics of Poultry Farming

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Abstract

The profitability index of any productive venture depends partly on the nature of the work study adopted by the organisation. To this end, this work is aimed at investigating the effects of using standard ergonomic principles for egg productions in our farms as against the traditional methods of egg production. Also, the work will compare and evaluate the economics in the ergonomics of egg production, food consumption and sales of old stock after productive year as against the normal conventional crude way of poultry farming in most farms in southern Nigeria using available records.A ten-year data of egg collections, feed intake, average monthly cost of labour, cost of medications and monthly mortality rates in Marfes farms involving one thousand(1000) birds raised in a deep litter system was examined with respect to the cost of production and other variablesand compared with data collected from well organised ergonomic friendly arrangement of one thousand (1000) birds for egg production.The data obtained was analysed and subjected to statistical analysis (ANOVA) to determine the degree of variance from standard at 95 percent confidence interval.The result of our findings showed that there exists a significant difference between birds raised in a deep litter system and those in an ergonomically friendly environment, in terms of mortality rate, egg production, feed consumption, average cost of feeding and feed conversion rate. The result of the study again, revealed that Marfes farms loses about N3,035.46 daily as result of not using best agricultural practices. Irrespective of the initial high cost of establishing the standard pen, over time, it is cost effective, and yields a super return on investment.

Keywords:Ergonomics, Birds,Egg production,Environment, Productivity

Introduction

Animal husbandry is as old as nature, over the years, more sophisticated methods of raising animals are encouraged among farmers. However, due to the high cost associated with the installations and use of the battery cage system, automatic trolley feeders and drinkers, many farmers shy away from the use of these mechanised/modernised system of farming. Little did they know that it is less expensive over time compared to the deep litter system most farmers patronize because of its low set up cost. Here in the south - south region of Nigeria, only a few farmers practice mechanized system of agriculture, poultry in particular, this is basically because of the huge financial involvement. To further compound this problem of financial incapacitation of the farmers is the near unavailability of credit facilities to our farmers. Even when the credit facilities are available, either the interest rate will be too high with stringent conditions and or the farmers may lack the required collateral securities needed for such transaction. In addition to these myriads of constrains facing farmers development with regards to acquisition of credit facilities is the high risk involed in animal husbandry with specific regards to very high mortality rate. Invoking ergonomics principles as tools that combines method study, work study and time study among other variables to fashion out the best and the most economic way of carrying out a particular job is endorsed for this study.

This research work is therefore aimed at establishing the actual difference between the crude poultry system and the modern system of raising birds for egg production based on ergonomic principles in Delta state, one of the state in the south – south region of Nigeria. This work is important and interesting in that it will encourage, appeal, focus and direct farmers' attention to the best and the most economical way of raising birds predominantly for egg production.In consideration of the works carried out in a poultry system, the task analysis, work method modification, hand tool design and redesign are some of the important variables that requires proper study to aid re modification according to ergonomic rules. Again, the automation of the entire system to reflect good ergonomic standards and practices must be in place so as to optimise the health status of the workers as well as the birds in consideration. It is important to note that an improperly designed work station may result in the following medical conditions, these are rotator cuff injuries, muscle strain, low back injuries, carpal tunnel syndrome and tendinitis.Since all business outfit are aimed at maximizing profit, it is the desire of the authors to recommend the most appropriate ways of raising birds mainly for egg and meat production for greater performance that will enhance productivity. If this is not carefully done, the profit expected from this ergonomic arrangement will be eroded by health challenges of the perceived workers. Therefore, a balance must be striked between working environment, meat and egg production.

In recent times, some works have been done in this area of research, such works includes,Galip et al. (2012) who re

designed the grain and the egg collector system in a poultry farm to predominantly reduce the high rate of muscular skeletal disorders among workers and the birds. The paper observed a significant difference between the new design and the old one using a statistical package.Carvalho et al. (2015) also investigated the activities of workers working in a broiler hatchery section with a view to ascertaining the level of conformity of ergonomic practices and principles in the farm. The paper highlighted the possible medical conditions likely to be associated with the current practice and recommended a safer work method to the workers.

Jaspen et al. (2010) applied ergonomics principles and guidelines to carry out corrective effects of the old farming practices which often result to prolonged injuries due to continuous physical activity over a long period of time. The paper emphasized that jobs requiring the use of hand tools, lifting of heavy objects and stooped work should be carried out with regards to the recommended rules and regulations. Also, Nina and Lars (1997) studied the strain and the ergonomic needs associated with the four disabled farmers aged between 34 – 49 years. The paper analysed the strain at work based on their maximal heart rate (HR), the muscle activity (EMG) and the rating of their perceived physical exertion (RPE). The result of the work showed that the mean activity of the trapezius muscle was 0.4 – 9.0 % of the maximal voluntary contraction. Similarly, Hasan et al. (2014) used some review techniques to establish the extent to which ergonomist had worked in the area of ergonomic design, ergonomic task analysis, educational and epidemiological concept. The result of the study showed that ergonomist effort in developing a practical ergonomic task analysis for the intervention in Agricultural sector in both the developed and the developing countries of the World has been significant. In a related development, Kim (2016) carried out a research work on the nature of farm accidents exposed to farmers and proffer solutions based on ergonomic guidelines and principles. The paper added that a study of the applied recommendations showed a remarkable improvement in terms of health and safety of the workers. Also, Singh et al. (2014) re designed and carried out a holistic test on the old sickle as against the new sickle designed. The result of the study showed an increase of 19.5 % in terms of efficiency when the serrated sickle was used by women. The paper further added that about 19 % savings in cardiac cost of workers per unit of workers per unit of output was recorded as against the traditional method of harvesting wheat. Similarly, the working heart rate of the women was recorded to be 110 beats/ minutes, while the energy expenditure was 12KJ/s as recorded.

From sowing to harvesting in agricultural practices is usually labour intensive, during this period, the risk of developing epidemiological conditions are imminent mostly among women. This is majorly as a result of their improper posture in their respective workplaces, Chauhan and Saha (1991) added that ergonomic intervention is needed as a guiding principle to aid and assist farm workers. Jyotsna et al. (2005) and Weldema, (2001) noted that for farmers to enjoy good quality of life and achieve higher productivity, farm tools and equipment must be designed

ergonomically and must be user friendly. Among the hazards faced by farm workers as reported by (Walker and Palmer,2002) are slippery and uneven walkways, vibrations from farm vehicles such as tractors and Lawn Mowers. Others according to the paper include powered chain Saw and hand tools. In a related study using citrus harvesting in Brazil as a case study, Alves and Camarottra (2012) compared the quality of citrus fruits with respect to the associated cost of rehabilitating farm workers over time. The study revealed that even though it is cheaper to harvest citrus fruits using the crude method, the associated risk and the high cost of treating such farmers are on the increase. The paper recommended ergonomic intervention to reduce this ugly trend.

NIOSH (1997) listed the various types of work musculoskeletal disorders (WMSDs) in the agricultural industry to include epicondylitis, nerve entrapment syndrome, periteninites, tendinitis, tenosynovitis, and non-specific muscle and tenderness. The paper that only good ergonomics practices will promote the elimination of these health condition to a fairly acceptable standard. Cogbill et al.(1991) used a 12-year data to study 739 adult patients in a government hospital to ascertain the level of each industrial sectors contribution to the health challenge. The result of the study showed that permanent disability arising from several types of injuries obtain in agricultural sector are more common than any other branch of industry. The paper went further to recommend and encourage the design of farm tools that are user friendly. Also in India, Bhattacharya and Chakrabarti (2012) conducted a study in India on 180 female workers working in a Tea farm. The study involves the design of an ergonomically friendly tea basketfor plucking of tea leafs in a tea farm. The essence of the designed tea basket is to reduce the trauma faced by farm workers who are predominantly females in India.From the literature as presented above, it is evidential that ergonomics plays a vital role in agricultural practices, hence we can say that good ergonomics is good economics.

Method

A ten-year data of the mortality rate, feed consumption rate, feed conversion rate and egg production rate of one thousand birds specifically for egg production were taking from Marfes Farms Nigeria Limited, a farm involved in the breeding of birds from day old to maturity level for both table birds and for egg production. In the analysis of the data obtained from the management of the farm, the data were segmented into quarters for every year. It is important to note here that the birds in each pen are made to be equal in numbers at the start of every season during the period of investigation. This is to enable fair treatments of observed variables using statistical models. Also, in the assessment of the mortality rate, proper records were taken in both pens even though the numbers of dead birds were not constantly replaced from a pool of birds on the reserve/waiting stock.

The major reason for this irreplaceable condition in both pens is just to ascertain what the cumulative loses in terms of mortality rate for each pen in a period of ten years would be. It is instructive and interesting to note that no major disease outbreak was recorded throughout the period under review for this investigation.

In other to find out if there exist anydifference between both methods of farming in terms of egg production, feed consumption and mortality rate, and also to establish if such difference was significant, the analysis of variance, a statistical tool referred to as (ANOVA) was used to validate these hypotheses. Similarly, the cost of raising a unit bird using both methods will be compared using simple proportion method.

Table 1: Average mortality rates in both pens under investigation

Months	**Number of birds in the pen**		**Number of mortality in pen A**	**Number of mortality in pen B**	**Difference in mortality rate of A and B.**
	PEN A	**PEN B**			
1	1000	1000	08	08	Nil
2	992	978	02	13	11
3	980	965	12	18	06
4	963	947	17	06	11
5	946	941	17	08	09
6	930	933	16	NIL	16
7	930	929	NIL	04	04
8	930	925	NIL	08	08
9	930	922	NIL	01	01
10	930	921	NIL	NIL	NIL
11	930	921	NIL	18	18
12	930	921	NIL	NIL	NIL
13	930	921	NIL	NIL	NIL
14	930	921	NIL	05	05
15	930	907	NIL	06	06
16	930	901	NIL	02	02
17	930	899	NIL	01	01
18	930	898	02	NIL	02
19	928	898	NIL	05	05
20	928	894	NIL	NIL	NIL

From table 1, the rate at which the day old chicks die (mortality rate) was recorded. The records showed that for each pen a total of 1000 birds each were raised in a brooding house for four weeks, after which they were separated into their various pens. As it were, the cost of each dead bird were recorded against the pen where it occurred. This will often aid us in computing the ideal cost effect benefit of each method. The total cost of casualties was imbedded in the final sales analysis of the old stock after their useful year. Find below the average feed consumption rate as presented in table 2.

Table 2: Average feed consumption rate for birds in pen A and Pen B under investigation

months	No of birds in pen A	No of birds in pen B	Feed consumption Pen A (Kg)	Feed consumption Pen B (Kg)	Difference in feed consumption rate in (Kg)
1	1000	1000	350	350	0.00
2	992	978	903	915	12.00
3	980	965	1441	1468	13.00
4	963	947	1955	1987	13.00
5	946	941	2450	2494	44.00
6	930	933	2930	2986	56.00
7	930	929	2930	2973	43.00
8	930	925	2930	2983	60.00
9	930	922	2930	2950	20.00
10	930	921	2930	2958	17.00
11	930	921	2930	2958	17.00
12	930	921	2930	2958	17.00
13	930	921	2930	2958	17.00
14	930	921	2930	2958	17.00
15	930	907	2930	2956	28.00
16	930	901	2930	2984	54.00
17	930	899	2930	2978	48.00
18	930	898	2930	2974	44.00
19	928	898	2924	2974	50.00
20	928	894	2924	2961	37.00

Also, table 2 gives the average feed consumption rate of the two sets of birds under investigation for a period of ten years. From the record, the first four weeks has zero kilograms as the difference between their feed intakes simply because the day old chicks were raised under the same conditions for the said period under review. These records were subjected to critical statistical analysis of variance so that the result so obtained will aid farmers in deciding the choice of farming method to be employed.

Results

The results of the analysis as presented in table 3.0 showed that there is an observed difference between the egg production capacity of birds raised in a deep litter system and those raised in the standard practice of providing the cage system, automatic feeders and drinkers. Also of importance is the conditioning of the ambient air temperature in the standard poultry practice.

Table 3.0: Average egg production record for birds in Pen A and B. for ten years' period

Months of lay	Total no of birds left		Total no of eggs collected in pen A	Total no of eggs collected in pen B	Difference between eggs collected in pen A and B
	Pen A	Pen B			
1	928	894	1352	1341	11
2	928	890	5601	5340	261
3	928	890	5540	5400	140
4	925	890	5520	5365	145
5	923	882	9645	9520	125
6	923	882	12630	12518	112
7	923	881	21345	21144	201
8	923	881	22200	22120	80
9	923	880	24021	23760	221
10	923	880	19528	19000	528
11	923	880	19302	18520	782
12	923	880	18211	18089	122

The major aspect of the study was to establish if there exist any significant difference between the number of eggs laid by birds raised in the deep litter system and those raised on the standard pen where all conditions are made to satisfy the environmental requirements of birds in the tropical region. As seen in table 3, the rate of mortality increases progressively in both pens. Similarly, egg production equally droped in proportion to the mortality rate, all these will affect the profitability index of the system Table 4.0 gives a descriptive model of the summary of our findings using a ten-year data plan obtained from Marfes farms Nigeria Limited.

Table 4.0: summary of the ten-year record of egg production in Marfes farms for both pens

years	No of Birds		Feed used in the pen		Eggs collected		Broken Eggs		Total mortality		Rate of cannibalism		Badly formed eggs	
	Pen A	Pen B	Pen A Kg	Pen B Kg	Pen A	Pen B	Pen A	Pen B	Pen A	Pen B	Pen A	Pen B	Pen A	Pen B
1	929	906	48000	50102	233783	207776	367	422	71	94	04	12	243	361
2	925	904	47950	50250	244404	229950	339	431	75	96	01	09	136	246
3	927	888	48310	51140	249572	239845	312	387	73	112	00	16	143	204
4	932	897	48107	51723	251107	223628	246	456	68	103	02	13	148	186
5	918	902	47932	50983	247266	211043	249	378	82	98	00	08	137	211
6	930	897	48112	51109	237571	215584	302	349	70	103	03	05	132	125
7	928	898	48104	50875	242994	213981	316	376	72	102	01	08	156	86
8	914	904	47934	51650	245321	221519	287	350	86	96	02	03	124	140
9	919	878	47976	50982	239714	226919	275	421	81	122	02	05	126	143
10	937	895	48226	51525	240544	216372	301	417	63	105	03	07	102	138

The statistical analysis which involves the use of analysis of variance (ANOVA) showed a remarkable difference between the two sets of birds at the respective years. Similarly, the cumulative result showed that there exists a significant difference at 95 % level of confidence between the two sets of birds. In addition to this, it was observed that the unit cost of raising a bird in the traditional deep litter system is much higher than that required to raise one in an ergonomically built pen as compared using the arithmetic simple proportion method. Also with a significant drop in the rate of cannibalism and mortality rate, the managers of marfes farms records high profits all year round. Therefore, in spite of the initial high cost of establishing ergonomic friendly farms, it pays off within a very short period of time.

Conclusion

Evidentially, from the data gathered and results obtained from the analysis of information provided byMarfes Farms Nigeria, it is certainly obvious that the advantages derived from the improved ergonomic standard farms outweighs the local way of farming which involves the raising of birds using the conventional deep litter system or the semi free range system, more precisely, the local way of raising birds in a deep litter system. In addition to this, it cost more to prevent and control disease outbreak in the local farms. From records available for the purpose of this study, it was observed, proved and confirmed after statistical analysis that birds raised locally has a mortality rate of about (18 – 22) % throughout their life time, this figure excludes times of pronounced disease outbreak. while those raised using the standard ergonomic practice has a mortality rate of about (5 -7) % and are less exposed to disease outbreak. similarly, on feed consumption rate, it was equally deduced that birds raised locally, consume more food than those on the battery cage system with all other ergonomic facilities put in place. This excess food consumption was primarily due to their physical exercise and movement which requires additional energy to accomplish. Secondly, the rate at

which feed are being wasted because of their access to the feeding through is on the high side when compared to the other birds raised in cages. Cumulatively, Marfes farms loses about three thousand, and thirty-five naira, forty-six kobo (#3,035.46) which translate to about eight ($8.0) on daily basis for not using standard agricultural practices based on ergonomics principles in one arm of the farm.

Again, cannibalism which is a serious factor among birds raised on a free range system was more experienced in pen B. The cumulative effect of all these profit depleting avenues is excessive high cost of production which negates the major objective of any productive venture. Finally, from the egg production and collecting records, it was obvious that birds from the free range system and or those raised in the deep litter system produce fewer eggs when compared to those raised using the standard practices. This is partly attributed to the risk of breakages experienced in the deep litter system.

Conclusively, the result of our findings showed that the installations of ergonomic standard farms are initially expensive to come by, however, over time, the farmer will certainly begin to enjoy the dividends of investing in such agricultural practices, in the area of good yield, high rate of returns, less labour usage which reduces the cost of production and many other inherent advantages, egg production not an exception.Cumulatively, result showed that the standard method of egg production in Marfes farms was in excess of 19.5 % compared to the local deep litter system of the same farm as recorded. It is therefore instructive to state that good ergonomics is good economics. Good farm economics translate to high profit making which is the desire for all well-meaning farmers to be in business. Furthermore, workers are highly motivated as a result of high yield occasioned by the use of ergonomic principles. Similarly, because of the design and redesign of farm equipment, workers' health conditions are often sustained, this in turn reduces the idle time and the amount spent on rehabilitation of workers when the need arises.

This finding is positioned to serve as a guild and policy instrument to poultry farmers, government agencies, philanthropist, non-governmental organisations and policy makers in the way forward to adopting ergonomic practices in our mechanised system of farming. The work also in a way provided the cost implication of raising birds from day old to maturity as provided.

References

Carlvaho C. C. S, Souza, C. P, Tinovo, F. P., Santos, L. V, Minette, L. I and Silva E. P. (2015) Activities and Ergonomics of Workers in Brioler Hatcheries. Brazillian Journal of Poultry Sciences, Vol. 17, No 2 pp (123 – 136)

GaliDileep K., Prakash Unakas U, and Supradip, D. (2012). Redesign of Grain Collector in Poultry Farm. SASTECH, Vol. 11, No 1 pp (99 – 106)

Jaspen, D. S, Kent McGuire and Daniel Poland (2010). Secondary Injury Prevention: Ergonomics for the Farm, Ohioability Fact Sheet Series AEX – 981 - 6 -10

Nina Nevala – Puranen and Lars Sorensen (1997) Physical Strain and Work Ergonomic in Farmers with Disabilities. International Journal of Occupational Safety and Ergonomics. Vol 3, No 1-2, pp 77 –88.

Kim I. J (2016) Accidents and Accident prevention in the Agricultural Industry: Ergonomic Engagement. Journal of Ergonomics, vol 6, No 3 pp (153 – 157)

Singh, Alka, Gautan, U. S, Singh Rajesh and Paliwal D. (2014) Ergonomic Study of Farm Women during Wheat harvesting by improved Sickle. African Journal of Agricultural Research, vol 9No 18, pp (1386 – 1390)

Hassan, S. N, Karmegan, K, Shamsul, B. T and Koustuv, D (2014) Ergonomics in Agriculture: An Approach in Prevention of Work – Related Musculoskeletal Disorder (WMSDs). Journal of Agriculture and Environmental Sciences, Vol 3, No 2 pp (35 – 51).

Chauhan, M. K and Saha D. N (1999) acceptable limits of physiological workload for physically active Indian Women. Advance Training Course in Ergonomics, SNDT Women's University, Munbai.

Walker B. K. and Palmer K. T. (2002) Musculoskeletal Disorders in Farmers and farm workers. Occup. Med. Vol 52, pp 441 – 450.

Jyotsna K. R., Singh, Y. P, Misra, Y. D, Singh S. and Singh, H (2005) Ergonomic Evaluation of the Rural Women while performing wheat Harvesting Activity. J. of Hum Ecol. Vol 18, No 4.

National Institute for Occupational Safety and Health (1997) Musculoskeletal Disorders and Workplace factors.

Alves Costa, S. E. and Camarottoa J. A (2012) An Ergonomic Approach to Citrus Harvest Mechanisation. Work, Vol. 41 pp (5027 – 5031)

Bhattacharya , N and Chakrabarti, D. (2012) Ergonomic Basket Design to reduce Cummulative TraumaDisorders in Tea plucking operations. Work, vol 41 pp1234 – 1238.

Cogbill, T. H, Steenlage, E. S., Lander Casper, J and Strutt, P. J (1991) Death and Disability from Agricultural injuries in Wisconsin; A 12-year experience with 739 patients. Journal of Trauma vol. 31, pp (1632 – 1637)

WaldemarKarwowski, (2001) International encyclopedia of ergonomics and human factors,
Volume 1, second edition.