The Effects of Housing and Equipment Status on Egg Yearly Monitored Production Rates in Open Poultry Houses in Gezira State, Sudan

Nura EL-Dikeir[1], Mohamed Y. M. ELBeeli[2], Awad Mohamed   Abdel-Rahim[3] Jumaa Barram Jadalla[*4] and Sayda Ahmed Mohamed Ali[5]

[1]Department of Animal Production, Faculty of Agricultural Sciences, Dalanj University, Sudan
[2]Department of Animal Production, Faculty of Agricultural Sciences, University of Gezira, Sudan
[3]Depatment of Animal Production, Faculty of Agricultural Sciences, University of Gezira, Sudan
[4]Depatmentt of Animal Production, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Sudan
[5] Department of Microbiology, Faculty of Technology, University of Gezira, Sudan

*Corresponding author`s Email: jumaaaringola2000@gmail.com

ABSTRACT

This study was carried out in Gezira state, Sudan to investigate the effects of housing and equipment status on egg production in open layer houses. Data were collected through individual interviews (questionnaire) of 97 randomly selected among poultry farm owners. The height of 80% of north and south sides of wall were 50-100 cm in Almanagil, 76.5% in Alkamleen and 57%in south of the Gezira localities, while the height of the wall side at the east and west were (3-3.5m) in all (100%) houses in east of the Gezira, 77.8% in Alhasahesa, 60% in Almanagil and 47.1% in Alkamleen. The width was 5-8m in most poultry houses in Gezira State's localities surveyed. In Greater Medani, all the houses were at the width mentioned above while 76.4% and 73.5% in of those building were 5-8 cm in Almanagil, and Alkamleen localities respectively. The most of wall houses were not painted where 50% of those houses were with painted walls in east of the Gezira and 76% in Alkamleen locality. The most floor types were made of bricks. Flours with that type were 55.6% in Alhasahesa and 76.5% in Alkamleen locality. The layer of sand was thin in the major litter type of poultry houses surveyed in Gezira state localities though some houses were without litter, which affect birds' performance by low ventilation and insulation. Round feeders of 40 - 50 cm length were the majority feeders' type observed. In Alhasahesa 55.6% houses had that type of feeders while all houses surveyed had round feeders in east of the Gezira and Greater Medani localities. Oil containers were used as drinkers in most poultry houses surveyed. The troughs were with unsuitable height for hens to drink conveniently. The percent of house with that type of drinkers were 58.8% in Alkamleen and south of the Gezira localities. Birds/feeder and birds/drinker capacity varied between 50 and 75 birds. Clay pots were the mostly used egg nest type in the state. That type of nests were used by 88.2% of farm owners in Greater Medani to 100% in east of the Gezira, Alhasahesa and Almanagil localities. In average one egg nest was allotted to 15 hens. Yearly monitored egg production ranged between 60-70%.

Keywords: Layer, Production constraints, Housing, Equipment

INTRODUCTION

Poultry production is an ancient activity and it has been practiced traditionally in different parts of Sudan. The growing demand of poultry meat and eggs motivated private sector to start commercial production of poultry. Concomitant with that, the government initiated modern poultry farming first in Khartoum and later in many city centers of the country. During the last decades both broiler and layer production gained momentum in Sudan. The fact that poultry is a good source of income and cheap provider of valuable protein products that are needed to secure human body with the essential amino acids encouraged its

expansion. Improved methods of poultry management were introduced to Sudan in the mid 1950s in Khartoum province, since then poultry industry started to grow gradually around Khartoum and other cities in the country (Habani, 2008). The establishment of the research and extension center in early 1960s, led to more development in poultry industry in Sudan (Osman, 1988). There were significant increase in numbers of modern farms established in Sudan, largely concentrated in big cities and communities in urban areas. There are numerous small private farms which are widely distributed in the urban areas and some rural

areas (Elzaki et al., 2011). Although feeding is the main challenges for commercial and small producers**,** housing has a crucial influence in poultry production. Itshould provide good protection from predators (Fanatico, 2007). Open sided poultry houses are constructed with its length extending from east to west direction to minimize the entry of direct sunlight, to exploit the direction of the prevailing wind and to minimize solar heat radiation (Viswanathan, 2001 and Winchell, 2001). A good location, with a good water source and a well-insulated building, equipped with proper ventilation, heating, lighting, feeding and watering system are important in all types of poultry housing(Winchell, 2001). Wall characteristics are important in good bird's welfare. So the house walls should be without cracks to prevent parasites availability. Walls must be painted with light colored paint such as white color, to reduce heat stress inside bird's house. The height of the sidewall in East-West directions will be around 3-4 meters. North-south direction sidewalls height will be about 0.5 meter to one meter and the remaining space must be covered with chain link mesh. Wall building materials include bricks, concrete bricks and other local materials (Jacob et al, 2014).Poultry house should have elevated ceiling to keep heat radiation away from the birds. Roof height must be about 3-4 meters. The width of the open sided deep litter house is around 8 to 10 m**,** length of the house determined by flock size and it could be up to 50 m (ElBeeli, 2009).Concrete floor is recommended to ensure all-weather operation, and to secure the birds against rodents and dogs. About 5–10cm thick layer of wood shavings, peanut hulls or other bedding materials, as sand, straw are used as an absorptive base (Grisso, 2009 and Sadkhan, 2011).Egg nests are very important in poultry house equipment; it is made of many different materials, the nest must be safe to the birds and to the eggs; it must distributed in the dark part of the house (Al-Haaisha, 2008).There are many feeder types made of plastic or metal, and get circular or longitudinal shapes. Birds spacing in circular feeder is about 2cm for a bird, and for the longitudinal feeder is about 10 cm for a bird (Merck Veterinary Manual, 2012).This spacing provides suitable area for birds and prevents birds crowding round feeders (Jacob et la., 2014). Minimum floor area per bird in square inches requirements for white leghorn egg-strain birds was reported by Brown (2015) being 60 square inches per bird at18 months of age onwards. Payne (1990) reported that a suitable feeding space for 100 layer birds is about 7.6 to 10.7 m (Payne, 1990).

MATERIALS AND METHODS

The present study was conducted in Gezira state, Sudan which lies between latitudes 13 - 15.2^0 N and longitudes 32.5 - 34^0 E. The total area about is 23373 km^2. The state is bounded by Khartoum in the north, Gedarif state in the east, White Nile State in the west and Sennar state in the south. The state is located within the semi arid climate which is characterized by seasonal and limited raining in the summer months (July-September).The Blue Nile River is the most important feature of the surface and is characterized by its course and its water though being low in salinity of high percentage turbidity during the rainy season (Sudan Metrological Services, 2005).The Gezira state was an approximately ranked second in poultry production in Sudan. Despite of that there was no enough information about birds housing and flocks management (Idris and Ahmed, 1997). A random sample was taken among layer farms owners for data collection of this study using questionnaires from the Gezira state localities (south of the Gezira, east of the Gezira, Alhasahesa, Almanagil, Alkamleen and Greater Medani) from April 5th to June 10th/ 2010. The questionnaire was consisted of poultry farms operation subjects, including questions in poultry housing, equipments, egg production. The data were then analyzed using Statistical Packaged for Social Sciences (SPSS version 20) at $P<0.05$ and Microsoft excel was used to analyze the collected data.

Ethical approval

Not applicable. This research did not involve the introduction of any intervention in/on birds, or direct collection of cells, tissues or any material from birds.
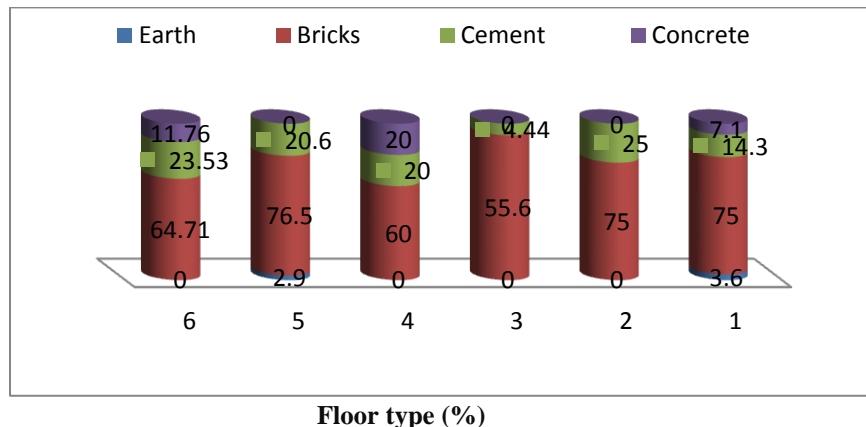
RESULTS

Poultry house status

Result showed that birds' house direction was from east to west in all localities (100%).The height of poultry houses at north and south sides were about 50-100 cm in most of Gezira State localities studied. The heights incited were reported by 80% in Almanagil, 76.5% in Alkamleen localities, by57% in South of the Gezira locality. Wall of 40 cm height was construed by44.5 %, 42.9 % and 41.2 % in Alhasahesa, South of the Gezira and Greater Medani municipality respectively. The height of eastern and western sidesof wall wasabout 3-3.5 m in the localities surveyed. All respondents (100%) reported having walls of that height in East of the Gezira, 77.8% in Alhasahesalocality,60% in Almanagil locality and 47.1% in Alkamleen locality. The width of the majority of house was about (5-8m) in most localities. It was about 100%, 76.4% and 73.5% in Almanagil, Greater Wad Medani and Alkamleen localities, respectively. It was observed that walls were not cracked though were mostly unpainted; status of walls indicated were 76%, 60% and 51% in Almanagil and South of the Gezira locality, respectively (Table 1).The most dominant floor types in poultry houses reported was made of bricks in Gezira State localities covered by this survey. This type was about 76.5%, 75%, 64.71%, 60% and 55.6% in Alkamleen, South and East of the Gezira localities, Greater Medani, Almanagil and Alhasahesa localities, respectively (Figure 1). Most houses were bedded with sand in localities. Such type of bed was followed by86.7% in Alkamleen, 82.4% in Grade Medani and 80% in Almanagil locality (Figure 2). Litter depth was less than 5 cm in most localities; the depth indicated was reported by100%, 88.3%, 82.6% and 80% in Almanagil, Grade Medani, Alkamleen and Alhasahesa localities, respectively (Figure 3).

Table1. Birds house longwise, width and status in poultry farms in different localities in Gezira state in Sudan
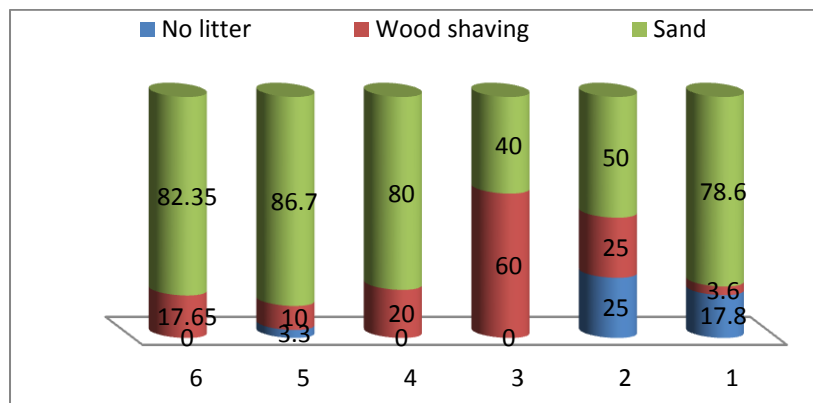
Locality	House direction%	House width (m)%				House status%					
		5 – 8	8 - 10	10 - 12	12 – 15	c.n.p	c.p	g.n.p	g.p	v.g.n.p	v.g.p
South of the Gezira	100	67.9	10.7	14.3	7.1	21.0	7.0	5.0	14.0	-	7.0
East of the Gezira	100	25.0	50.0	25.0	-	25.0	25	50.0	0.0	-	0.0
Alhasahesa	100	55.6	44.4	-	-	11.0	11.0	45.0	33.0	-	0.0
Almanagil	100	100.0	-	-	-	20.0	-	0.0	20.0	20.0	0.0
Alkamleen	100	73.5	23.6	2.9	-	9.0	3.0	76.0	6.0	6.0	0.0
Greater Medani	100	76.4	11.8	11.8	-	18.0	11.0	11.0	31.0	18.0	11.0

c.n.p: cracked and not painted; c.p: cracked and painted; g.n.p: with limited racks not painted; g.p: without cracks and painted; vgnp: very good not painted; vgp: very good painted

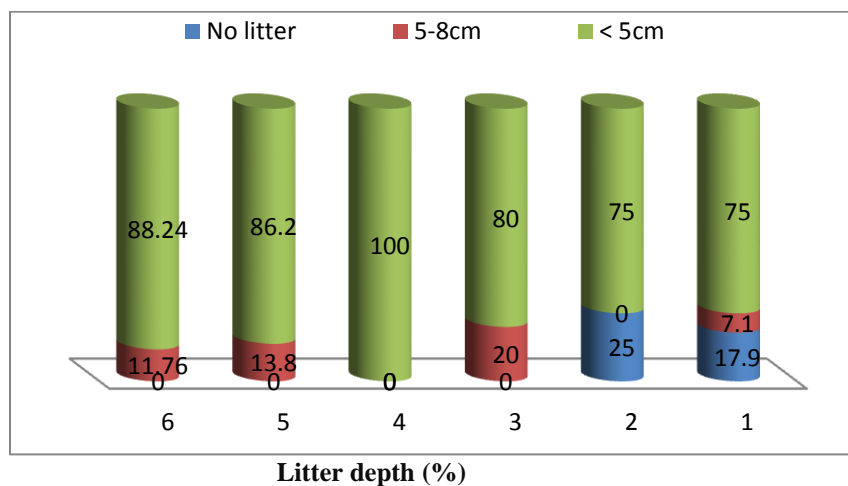**Floor type (%)**

Figure 1. Floor type of poultry farms in different localities in Gezira State, Sudan (Localities: 1: South of the Gezira. 2: East of the Gezira.3: Alhasahesa. 4: Almanagil.5: Alkamleen. 6: Greater Medani)

Litter type (%)

Figure 2. Litter type of poultry farms in different localities of Gezira state in Sudan (Localities 1: South of the Gezira. 2: East of the Gezira. 3: Alhasahesa. 4: Almanagil.5: Alkamleen. 6: Greater Medani)

Litter depth (%)

Figure 3. litter depth in the poultry farms in different localities in Gezira state in Sudan (Localities: 1: South of the Gezira. 2: East of the Gezira. 3: Alhasahesa. 4: Almanagil.5: Alkamleen. 6: Greater Medani)

Poultry house equipments

Feeder types and size were shown in (Table 2).Circular feeders were the main feeder type used in the Gezira State localities surveyed; This type was reported being used by all (100 %) of respondents in east of the Gezira and Almanagil localities, 97 % in Alkamleen, 89.3% in south of the Gezira and 88.24%Greater Wad Medani locality. Round feeders diameter was around (40-50 cm) in most Gezira State localities; This type was reported being owned by 100% 87.9% and 80% in east of the Gezira and Greater Wad Medani localities, Alkamleenlocality,Alhasahesa and Almanagil localities, respectively. Longitudinal feeders Size was about 100-150 cmin poultry houses in south of the Gezira, Alkamleen and Greater Wad Medani localities (Table 2). Birds/feeder varied in Gezira State localities; it was less than 50 birds in east of the Gezira locality (100%) and was about50 birds in Almanagil locality (60%)while it was about 75 birds in Greater Medani locality (82.4%) (Figure 4). Oil containers (jerricans) of 18 liter size was the main drinkers used in GeziraState localities; it was about 96.4%, 77.8%, 76.5%, 75%, 60% and 58.8% in south of the Gezira, Alhasahesa, greater Medani, east of the Gezira, Almanagil and Alkamleen.

Greater Medani, East of the Gezira, Almanagil and Alkamleen localities, respectively. Manual plastic drinkers were around 40% in Almanagil, 25% in East of

the Gezira and 22.2% in Alhasahesa localities. Birds/drinker varied between 50 and 75 birds in most localities. Fifty birds/drinker represented 53.6% in South of the Gezira and 53.1%in Alkamleen localities while 75 birds/drinker represents 82.35% in Greater Wad Medani and 55.6% in Alhasahesa localities (Table 3). Pots were the major egg nest type used in thelocalities; it was used by 100 % in East of the Gezira, Alhasahesa and Almanagil localities, 93.8% in Alkamleen and 92.9%in South of the Gezira locality (Figure 5). There were more than 15 birds per nest in most localities. This ratio represented 86.58%, 65.6% and 66%in Alhasahesa, Alkamleen and Almanagil localities, respectively (Table 4).

Birds egg production

Egg production rate was about (60-70%) in most of localities. That rate was reported by 83%, 75% and 60% in Alhasahesa, East of the Gezira and Almanagil localities, respectively.

The relationship between housing status and equipment and average egg production

Table 5, 6, 7, 8, 9 and 10 showed a positive relationship between well building house with suitable equipments and average egg production. When the house was well constructed and the equipments were as recommended the production rate was higher.

Table 2. Feeder type and size of poultry farms in different localities in Gezira state, Sudan

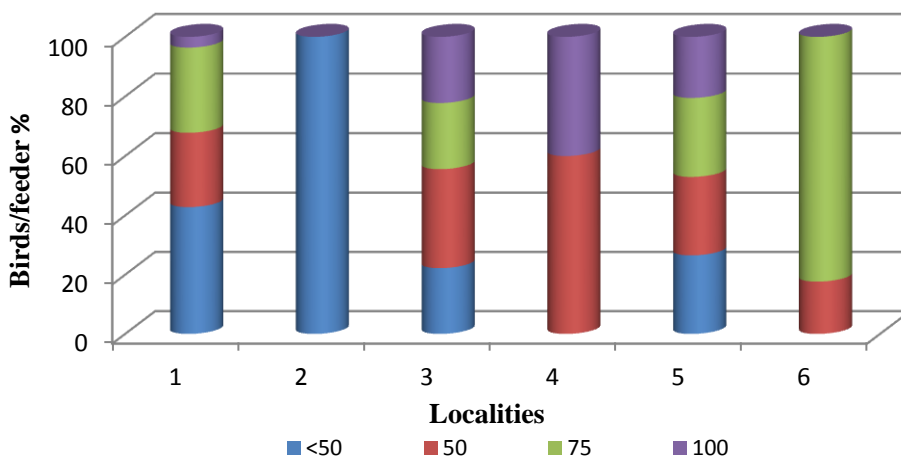| Locality	Feeder type (%)		Feeder size (%of owners)						
	Circular	Longitudinal	Circular (cm)			Longitudinal (cm)			
			<40	40-50	>50	80-100	100-150	150-200	>200
South of the Gezira	89.3	10.7	28.0	72.0	-	-	100.0	-	-
East of the Gezira	100.0	-	-	100.0	-	-	-	-	-
Alhasahesa	55.6	44.4	20.0	80.0	-	50.0	50.0	-	-
Almanagil	100.0	-	20.0	80.0	-	-	-	-	-
Alkamleen	97.1	2.9	12.1	87.9	-	-	100.0	-	-
Greater Medani	88.24	11.76	-	100.0	-	-	100.0	-	-

Figure 4. Bird's feeder in poultry farms in different localities in Gezira state, Sudan (Localities: 1: South of the Gezira, 2: East of the Gezira, 3: Alhasahesa, 4: Almanagil, 5: Alkamleen 6: Greater Medani)

Table 3. Characteristics of drinkers and number of birds per drinker in poultry farms in different localities in Gezira state, Sudan

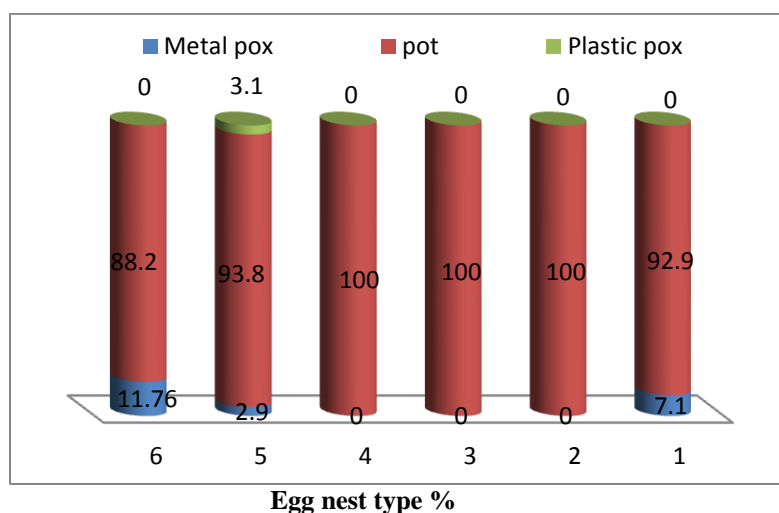| Locality	Drinker types (%)			Drinker (litter)				Bird/drinker				
	Manual plastic	Jerricans	Automatic	8	10	12	18	< 50.0	50.0	75.0	100.0	125.0
South of the Gezira	3.6	96.4	-	3.6	-	3.6	92.8	14.3	53.6	21.4	10.7	0.0
East of the Gezira	25.0	75.0	-	25.0	-	-	75.0	-	50.0	25.0	25.0	0.0
Alhasahesa	22.2	77.8	-	22.2	-	-	77.8	1.11	22.2	55.6	0.0	1.11
Almanagil	40.0	60.0	-	40.0	-	-	60.0	20.0	20.0	40.0	20.0	0.0
Alkamleen	20.6	58.8	20.6	29.5	2.9	8.8	58.8	-	53.1	34.3	6.3	6.3
Greater Medani	17.6	76.5	5.9	17.65	0.0	0.0	82.35	-	-	82.35	11.65	0.0

Figure 5. Egg nest type in poultry farms in different localities in Gezira State, Sudan (**Localities:** 1: South of the Gezira. 2: East of the Gezira. 3: Alhasahesa. 4: Almanagil. 5: Alkamleen. 6: Greater deMedani)

Table 4. Egg production /year and birds per egg nest in poultry farms in different localities in Gezira state, Sudan

Locality	Egg production /year %					Birds/egg nest %			
	<60%	60-70%	70-80%	80- 90%	>90				
						5.0	6 -10	11-15	> 15
South of the Gezira	4.0	39.0	25.0	18.0	14.0	3.6	-	39.3	57.1
East of the Gezira	-	75.0	25.0	-	-	25.0	-	50.0	25.0
Alhasahesa	-	80.0	20.0	-	-	-	6.7	6.7	86.6
Almanagil	40.0	60.0	-	-	-	-	-	40.0	60.0
Alkamleen	6.0	31.0	22.0	41.0	-	-	-	34.4	65.6
Greater Medani	11.0	39.0	25.0	18.0	7.0	-	17.7	29.4	52.9

Table 5. Correlation between wall status and average egg production (%) in poultry farms in Gezira State, Sudan

Parameters studies	Percent respondents	Pearson correlation
Status of wall		
Cracked and not painted	15.5	
Cracked and painted	7.2	
Good and painted	52.5	
Very good and not painted	6.2	0.819**
Very good and painted2.1	2.1	
Daily egg production percentage		
< 60 %	36.1	
60-70 %	52.6	
70-80 %	11.3	

** Correlation is significant at 0.01 level

Table 6. Correlation between floor types and average egg production in poultry farms in Gezira state, Sudan

Parameters studied	Percent respondents (%)	Pearson correlation
Type of floor		
concrete	5.2	
Cement	21.6	0.696**
Bricks	71.1	
Earthen	2.1	
Average egg production (%)		
< 60 %	36.1	
60-70 %	52.6	
70-80 %	11.3	

** Correlation is significant at 0.01 level

Table 7. Correlation between litter depth and average egg production in poultry farms in Gezira state, Sudan

Parameters studied	Percent respondents (%)	Pearson correlation
Litter depth (cm)		
< 5cm	82.5	
5-8 cm	16.5	0.637**
No litter	1%	
Average egg production (%)		
< 60 %	36.1	
60-70 %	52.6	
7 0-80 %	11.3	

** Correlation is significant at 0.01 level**.**

Table 8. Correlation between birds/feeder and average egg production in poultry farms in Gezira state, Sudan

Parameters studied	Percent respondents (%)	Pearson correlation
Birds/feeder		
>50	24.7	
50	23.7	0.874**
75	35.1	
100	16.5	
Average egg production (%)		
< 60 %	36.1	
60-70 %	52.6	
70-80 %	11.3	

** Correlation is significant at 0.01 level.

Table 9. Correlation between drinker types and average egg production in poultry farms in Gezira state, Sudan

Parameter studied	Percent respondents (%)	Pearson correlation
Drinker types (%)		
Manual plastic	16.5	
Jerricans	75.3	0.720**
Automatic	8.2	
Average egg production (%)		
< 60	36.1	
60-70	52.6	
70-80	11.3	

** Correlation is significant at 0.01 level

Table 10. Correlation between birds/drinker and average egg production in poultry farms in Gezira state, Sudan

Parameters studied	Percent respondents	Pearson correlation
Birds/drinker		
<50	6.2	
50	39.2	0.867**
75	41.2	
100	10.3	
125	3.1	
Average egg production (%)		
< 60 %	36.1	
60-70 %	52.6	
70-80 %	11.3	

** Correlation is significant at 0.01 level**.**

DISCUSSION

Feeder space allocation/hen, stocking density, and other aspects of the housing environment can affect the productivity of laying hens housed in cages (Bell and Weaver, 2002).

Bird's house direction that had been found in this study was in line with the findings of Viswanathan (2001) and Winchell (2001) to provide good ventilation in birds' house and to avoid heat stress. The most house width in the present study disagrees with ElBeeli (2009) who mentioned that a width of 8-10 m was best for keeping the birds in good ventilation. The floor and litter types were in line with the findings of Fanatico (2006), Grisso (2009) and Sadkhan (2011). Litter depth of 2-5 cm was in disagreement with the previous findings Grisso (2009) who mentioned 5-12cm depth and Sadkhan (2011) who reported (5-10 cm) for well moisture absorption. The results of this study might be attributed to the desire of farm owners in reducing production cost by using very thin litter layers. Use of plastic containers previously used for oil jerricans as drinkers may be due to their availability at low price. Such a trough did not provide adequate drinking space for the birds. Birds/feeders found in the present study was different from those reported by Payne (1990) and Jacob et al. (2010)who mentioned about 10 cm for a single bird per longitudinal feeder and 2 cm in round one as efficient space. This spacing allowed 7.6 -10.7 m for hundred layer birds, respectively and was important to provide adequate feeding space and prevent birds crowding around feeders. Birds/drinker was different from Payne (1990), Ward and McKague (2007) findings who reported 2.5m for 100 birds, and about 10 cm for a single bird to provide well drinking space and to prevent birds crowding around drinkers. Pots were the main egg nest type in the Gezira State localities and might be due to its availability, safety for birds and cheaper price. Birds/nest disagreed with the previous observations of Sonyia (2000) who mentioned (8-10 birds) to provide adequate egg laying space for each bird.   .

Englmaierová et al. (2014) studied the effects of laying hens housing system on laying performance and found that the housing system significantly (P< 0.001) influenced the performance characteristics. The authors observed that the highest egg production, lowest daily feed consumption, and feed conversion ratio were measured in conventional cages compared to litter and aviaries. Holt et al. (2011) studied and found that a move from conventional cages to either an enriched cage or a non cage system might have affected the safety or quality or both of the eggs laid by hens raised in that new environment.

CONCLUSION

The result indicated that most poultry houses; length were from east to west, and most of the houses wall were not painted. Bricks were the most floor type and sand in a very thin layer was the most houses litter, beside some of the houses were not bedded. Most feeder type was the round one of 40to50 cm diameter and oil containers were the most drinkers' type. Birds/feeder and drinker were varied. Pots were the most egg nest type and birds/egg nest were very high in most houses. It was concluded that housing and equipment provided were not all in agreement with standards of layer hens housing and equipment provision of optimal environment. That is why production rates were low.

Competing interests

Authors have declared that there is no competing interest.

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