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Productive and Reproductive Performances and Status of Chicken Breeds in Two Districts of South-Omo Zone, Ethiopia

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Abstract

The study targeted the productive and reproductive performance and status of breeds was conducted in two districts of the South-Omo zone, Ethiopia. A purposive sampling method was used to select districts, kebeles, and households and then, stratified to local, exotic, and mixed-breed rearing households. The composition of pullets (3.603), chicks (3.5), and layers (3.39) were highest than that of Cockerels (2.107) and Cocks (1.79). The more eggs/clutch/hen (26.2), the highest matured body weight (3.26 Kg), and the fast age of sexual maturity (5.4 months) were recorded for exotic breeds than the hybrid and local. The hatchability difference was due to the difference in broody hen, egg source, egg duration, egg size, and the season of hatching. The traits such as mothering ability, disease resistance, and production with conditional supplementation of the local breed were diluted. The productive and reproductive performance of the local ecotypes was low and the improved breeds not expressed their full genetic potential. The population of local breeds was diluted and decreased, antagonistically, that of the exotic breeds is increasing, and if it is not terminated near future we will lose distinctive traits of local breeds. Hence, regular supplementation of feed and conservation of exploiting genes were recommended to exploit the full genetic potential of breeds and sustain the diluting genes of local breeds, respectively.

Keywords: *Breed, Chicken, Exotic, Local, Mixed and Rearing*

Introduction

Chickens dominate the other genetic resources of animals in terms of number (65 million) and play as a source of food and income [1]. In Ethiopia, chicken production plays a significant role in aspects such as food security, income generation, and religious purposes [2]. The poultry subsector is also a suitable business due to its less land and initial cost requirement [3].

Of all the chickens in Ethiopia, the local breed covers about 78.85% and the remaining 21.15% were improved and hybrid [4]. The highest proportion of flocks was covered by laying hens (34.26%), followed by chicks (32.86%), pullets (11.36%), cocks (11.2%), cockerels (5.74), and spent hens (4.59%) [4]. The local breeds are known for low egg production, late age of sexual maturity, low body weight, and spending a long time without production while brooding, due to their weak genomic potential. Similarly, the output was disproportionately low compared to the higher chicken number and the fast-growing human population [5]. The productive potential of local breeds was not satisfactory to meet the fast-growing population demand [6]; whereas, exotic breeds produce around 250 eggs/year/hen [7].

To replace the less productive local breeds with exotic breeds, different attempts such as introducing fertile eggs and day-old chickens and crossing those with the local ones have been made for the last several decades. The improved breeds such as Rhode Island Red, Australop, New Hampshire, and White Leg Horns were the first introduced breeds in Ethiopia and the Debre Zeit Agricultural Research Center played a vital role in evaluating the productive performance of these breeds and others (Brown Leghorn, Light Sussex, and Barred Rock) [3]. In Ethiopia, the improvement of local breeds was focused importation of temperate breeds, but due to

poor management, lack of input, feed shortage, less adaptation to the tropical environment, and absence of veterinary drugs and vaccines, it is still unsatisfactory [8].

However, no scientific research conducted on the chicken flock composition, stock sources, productive performance, mating, brooding, available breeds, and their status. Knowing these parameters provides vital information to make the right decisions for smallholder chicken producers. So, conducting this research may give new and baseline statistics for the policy designers for further decisions on the breed's management and production. Therefore, this study was targeted to assess the productive and reproductive performance of breeds and their status in the two districts of South-Omo Zone, Ethiopia.

Materials and Methods

Ethical statement

The ethical approval was obtained from the Jinka Agricultural Research Center (No. JARC-213-02-07-00-010/2020). All ethical issues were considered while collecting the data.

Description of the Study Area

The study was conducted in the Debub-Ari and BenaTsemay districts of the South Omo Zone, Ethiopia. A detail of the study area is illustrated in the map (Figure 1) below.

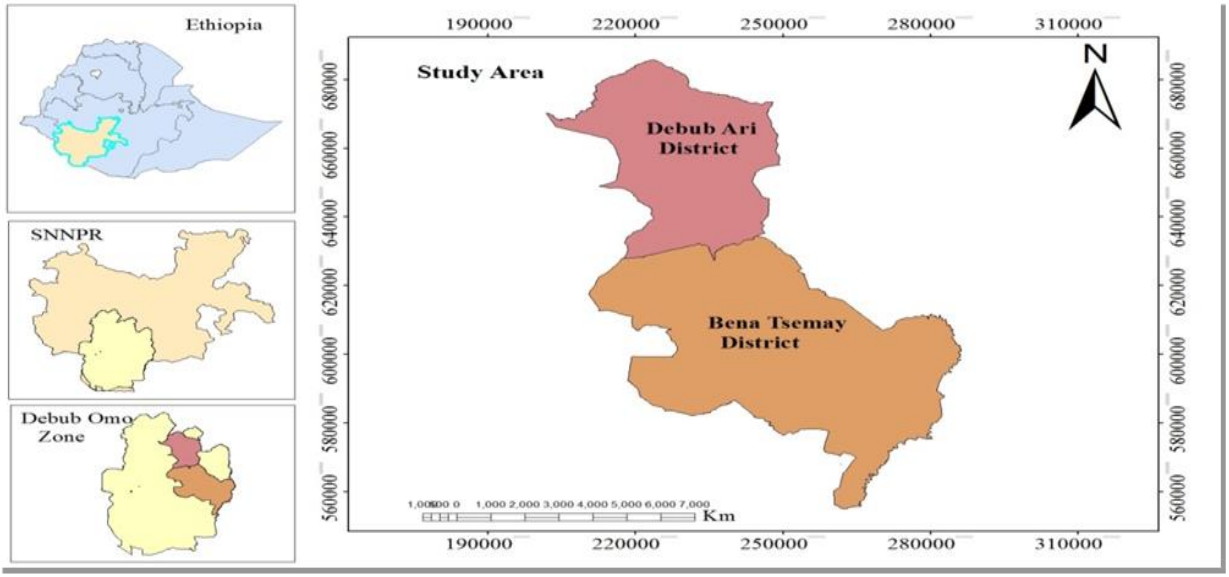

Fig 1: the map of the study district.

Selection of the study area

A purposive sampling method was used to select districts and Kebeles based on their chicken-rearing practices. Six kebeles from 2 districts and 30 households with better chicken-producing practices were selected from each kebele, and then stratified to local, exotic, and hybrid rearing strata. A total of 180 households were selected to collect information focusing on flock composition, stock sources, productive performance, mating, hatching, available breeds, and their status from the member(s) of households directly responsible for the management of chickens.

Data Collection

Before the actual data collection, a structured questionnaire was prepared and pre-tested. The interview was conducted at the farmers' residences with the assistance of development agents. Data like the flock composition, initial flock sources, number of eggs/hen/year, age at first egg laying, number of clutches/year/hen, number of eggs/brood, number of chicks hatched/brood, number of chicks survived were collected based on farmers recall response. In addition, data like mating, hatching, available breeds, and status of breeds were also collected. To know the matured body weight of chickens at the age of sexual maturity, 180 chickens (60 local, 60 improved, and 60 hybrids) were selected and weighed using a sensitive weighing balance.

Statistical Analysis

Descriptive statistics such as mean, standard error, frequency, and percentage of data were analyzed using the statistical package for Social Science version 16 [9]. The chi-square test was determined for the data expressed in the form of percentage and frequency. The descriptive statistics such as mean and standard error were subjected to analysis of variance to determine the significant difference among the three chicken breed-rearing strata.

Results and Discussions

Table 1: Flock size and composition per household

Variables	Strata (Mean ±SE)				p-value	LS
Number of chickens per household	Local (N=60)	Exotic (N=60)	Mixed (N=60)	Overall (N=180)		
Number of chicks	3.77± 0.34[a]		3.23±0.5[b]	3.5±0.42	0.00	***
Number pullets	1.97±0 .21[c]	3.52±0.45[b]	5.32±0.73[a]	3.603±0.46	0.00	***
Number of cockerels	1.33±0.18[b]	2.87±0.29[a]	2.12±4.44[ab]	2.107±0.30	0.004	*
Number of layers	2.63±0.13[c]	3.47±0.19[b]	4.07±0.25[a]	3.39±0.19	0.00	***
Number of cocks	1.48± 0.13	2.03±0.22	1.87±0.28	1.79±0.21	0.19	Ns
Average total	11.2±0.98[b]	11.9±1.15[b]	16.6± 2.19[a]	13.22±1.44	0.00	***

[abc] means in the row with different letters are different. Ns = Not significant ($p>0.05$); *** = significant at $p<0.001$; * = significant at $p<0.05$; N = Numbers of households; and LS = Level of Significance. Figures in the table represent means and standard errors.

There were significant differences (p<0.001) among the three chicken breed-keeping strata in chicks composition and the improved breed-keeping strata had no chicks since the birds were synthetic egg-laying types. The highest number of pullets in the mixed breed keeper strata was due to the presence of broody hens for hatching and additional purchasing of exotic pullets. Similarly, the highest number of layers in the mixed breed keeping strata was due to the presence of local breeds for hatching purposes in addition to the exotic layers. The number of pullets, chicks, and layers dominated the flock composition than the Cockerels and Cock. A larger proportion of hens in the flock followed by pullets, chicks, cockerels, and cocks in the Bishoftu area [10], but a larger proportion of layers was reported by [11].

The average numbers of chickens per household were highest in mixed-breed keeper strata, due to the higher access for replacement stock (chicks and pullets) from the own farm. The higher overall flock composition was reported than Meseret [12]; 6.23 chickens/household. However, a lower result was reported by Guraga [13], 22.3 and 14.7 chickens/household for mid and lowland altitudes, respectively.

Sources of initial stock

The number of respondents that got initial stock through hatching was more in the local breed-keeping strata (61.7%), due to the presence of broody hens, but there were no chicks in the improved breed-rearing strata due to the absence of broody hens. Similarly, about 15.6% and 20% of the farmers hatched naturally in the Ada'a and Lume districts, respectively, [14]. The proportion of chicken keepers that got initial stock through purchase was highest in improved breed-keeping strata (45%) because it was the second means of getting initial rearing stock. Similarly, the main source of initial rearing stock was purchasing for Bure (93.9%) Fogera (43.7%), and Dale (97.5%) districts [15].

Securing the initial stock through extension was highest in the improved breed-keeping strata (48.3%) and extension plays a vital role in the dissemination of improved breeds. Similarly, chicken keepers rear the improved breeds that are distributed through the extension [15]. But, in the case of local breed-rearing strata, there is no habit of getting initial stock through extension. Minor proportions of chicken keepers in the mixed (10%) and exotic (6.7%) breed-keeping strata get initial stock through NGOs and Research Centers.

Generally, hatching and purchasing were the main means to get the initial stock of local breeds. Due to the absence of government-owned poultry multiplication and breeding centers, farmers get improved breeds from cooperatives. Similarly, the chicken-rearing households get initial stock from private farms such as Alema and Genesis [16], and the majority of farmers in Ada'a (84.4%) and Lume (80%) districts get from private [14].

Table 2: Sources of rearing and breeding stock per household

Variables	Strata				X^2-test	P-value	LS
Chicken sources	Local (N=60)	Exotic (N=60)	Mixed (N=60)	Total (N=120)			
Hatched	37(61.7)[a]	0(00)[c]	15(25)[b]	52(28.9)	75.9	0.00	***
Purchased	23(38.3)[b]	27(45)[a]	15(25)[c]	65(36.1)	75.9	0.00	***
Extension	0(00)[c]	29(48.3)[a]	24(40)[b]	53(29.33)	75.9	0.00	***
Research center/NGOs	0(00)[c]	4(6.7)[b]	6(10)[a]	10(5.57)	75.9	0.00	***

[abc] means in the row with different letters are significantly different; *** = significant at $p< 0.001$ and; N = Number of households and LS = Level of Significance. Figures in the table represent frequency and percentage.

Productive and reproductive performance of breeds

The late age at first egg-laying was recorded for local breeds (6.81 months) due to their lower growth potential. The late age at sexual maturity (5.4 months) was recorded for improved breeds in the present study than the report of Nebiyu [16], the mean age at first egg-laying was 4.6 months, and Aman et al. [17], 4.76 months for Sasso, attributed due to the breed, feed and agro-ecology differences.

The matured body weight was higher for exotic layers (2.898 kg) due to their highest feed conversion ratio. Similarly, the average body weight of the SASSO breed at the age of sexual maturity was 2.73 kg [17]. The highest matured body weight was recorded for exotic cocks (3.259 kg) than the local and hybrid, due to the highest genomic potential to convert feed, and the average body weight of the SASSO breed ranges between 3.37-3.38 kg [18].

The highest average number of eggs/clutch/hen was recorded for the exotic layers (26.2) than the local (10.12) and hybrid (19.17), due to their highest genomic potential and the farmer's attention on exotic breed feeding. The number of eggs/clutch/hen of hybrid chicken was 19.17 eggs; lower than the productivity of improved breeds. Similarly, 12.6 eggs/clutch/hen were reported for local breeds [17].

The time gap between clutches was highest for local breeds and lowest for exotic breeds due to the presence and absence of brooding, respectively. Due to the absence of record-keeping the number of rest days between the clutches and the number of clutches/year/hen was not known for improved breeds, and it depends on the quality of supplemental feed and breed. The number of days/clutch was 26.2 days [19] and the number of clutches/year/hen was 3.43 for the Gomma district [12].

The number of eggs set/brood/hen was nearly similar for the local and hybrid breeds. The average number of chicks hatched from the same number of eggs for the local and hybrid chickens was 5.93 and 4.84 chicks which show that the local breeds have a better ability to hatch more numbers of chicks than hybrids due to their un-diluted genomic potential. Based on the season of the year and the hen's ability; farmers set 12.2 eggs/hen/brood for local hens [20], and the average number of eggs set/hen was 13 with the average number of chicks hatched/hen/brood of 11 [15].

Table 3: Productive and Reproductive performance of chickens

Variables (Mean ±SE)		Strata's			p-value LS	
Chickens productive and reproductive potential	**Local (N=60)**	**Exotic (N=60)**	**Cross (N=60)**	**Overall (N=180)**		
Age of sexual maturity	6.81±0.11^{c}	5.4±0.10 ^{a}	5.9±0.09^{b}	6.04±0.102	0.00	***
Matured Bw of the hen	1.37±0.04^{c}	2.90±0.08^{a}	1.65±0.02^{b}	1.971±0.15	0.00	***
Matured Bw of cock	1.56±0.04^{c}	3.26±0.09^{a}	2.01±0.03^{b}	2.28±0.054	0.00	***
Nº of eggs/clutch/hen	10.12±0.2^{c}	26.2±0.7^{a}	19.17±0.6^{b}	18.5±0.52	0.00	***
Nº of days/clutch/hen	14.7±0.46^{c}	31.7±1.15^{a}	24.80±1.0^{b}	23.75±0.9	0.00	***
Nº of clutches/year/hen	2.85±0.08	Na	2.98±0.106	2.92±0.09	0.324	Ns
Nº of eggs/brood/hen	9.03±0.214	Na	9.61±0.254	9.29±0.17	0.082	Ns
Nº of chicks/brood/hen	5.93±0.12 ^{a}	Na	4.84±0.13 ^{b}	5.46±0.11	0.00	***
Nº of chicks surviving	4.02±0.13 ^{a}	Na	3.2±0.134 ^{b}	3.65±0.18	0.00	***

^{abc} means in the row with different letters are significantly different, Ns = Not significant ($p> 0.05$), *** = significant at $p<0.001$, N= Number of households, Nº = number LS = Levels of Significance, Na = Not available, BW= body weight, and No = Number. Figures in the table represent means and standard errors.

There were significant (p<0.01) differences among the local and crossbreed breed-keeping households regarding number of chicks surviving/brood. The number of chicks surviving to adulthood was higher in local breeds, due to their intelligence to detect predatory birds and animals. The number of chicks that survived to adulthood was 79.8% for the Areka area [21] and 53.5% for the Southwestern parts of Ethiopia [22].

Incubation and storage practices

The number of chicks hatched from the set of eggs was significantly ($p<0.001$) greater for the local breeds than cross breeds (Table 4). This hatchability difference might be due to the broody hen's ability; source and duration of the egg, egg size, and season of hatching. The chicken keepers used the natural broody hen and increased or decreased the number of eggs depending on the size and last experience of the broody hen. In this study lower hatchability

(58.77%) was recorded than Emebet [23]; 76.6%. The local broody hens were the only means for incubation and brooding [15], and natural incubation was the most commonly used method for replacing the flock [12].

The storage time of table eggs was highest for local breeds whereas lowest for exotic (Table 4); due to their genetic difference the egg-laying frequency of local breeds was not daily; this increases the number of days for storage. But, in the case of exotic breeds, the egg-laying frequency was daily, and the number of days for egg storage became shorter. The eggs stored for long periods have lower hatchability than the fresh eggs. Chicken keepers were stored for 1.7 weeks before incubation [20].

Table 4: Incubation and storage practices of the eggs

Variables (%)		**Strata's**			**p-value**	**LS**
Incubation and storage	**Local (N=60)**	**Exotic (N=60)**	**Mixed (N=60)**	**Overall (N=180)**		
No of the egg set	9.03±0.21[a]	Na	9.61±0.25[a]	5-13(9.3±0.17)	0.082	Ns
No of hatched	5.93±0.12[a]	Na	4.84±0.13[b]	3-7(5.5±0.11)	0.00	*
Storage (days)						
Table egg	12.6±0.34[a]	8.6±0.23[c]	10.15±0.4[b]	4-20(10.8±0.4)	0.00	*
Incubation egg	10.5±0.37[a]	8.5±0.26[b]	7.48±0.33[c]	3-15(8.83±0.3)	0.00	*

[abc] means in the row with different letters are significantly different; Ns = Not significant; at *p>0.05;* * = significant at *p<0.005*; N = Number of households; Not available; and LS = Level of Significance. Figures in the table represent means and standard errors.

Chicken mating practice and traits

Egg and meat production were the most preferred traits for all breeds, but, hatching and mothering ability were the special traits of local breeds while selecting hens. Body weight and physical appearance were the most preferred traits when selecting cocks of all breeds. However, uncontrolled chicken mating caused the dilution of the most important traits of local breeds. Due to the absence of awareness, the farmers don't consider the exotic breed's effect on environmentally adapted local ones. The chicken keepers considered egg productivity as the main selection criterion [24], perpetuation of itself was natural mating and Artificial insemination was not common [25]. 86.1% of respondents didn't know the effect of uncontrolled mating on traits of indigenous breeds [20].

Table 5: Chicken mating and breeding practice

Variables (%)		**Strata**		**X^2-test**	**P-value**	**LS**
Selection for mating	Local (N=60)	Exotic (N=60)	Mixed (N=60)	Overall (N=180)		
Practice of breeding hen selection					0.57	0.75 Ns
Yes	20(33.3)	24(40.0)	22(36.7)	66(36.7)		
No	40(66.7)	36(60.0)	38(63.3)	114(63.3)		
For which trait					14.204	0.08 Ns
Egg productivity	8(40)	15(62.5)	9(40.9)	32(48.48)		
Mothering ability	5(25)	Na	4(18.2)	9(13.64)		
Brooding/hatching	3(15)	Na	4(18.2)	7(10.61)		
Body weight	4(20)	7(29.2)	3(13.6)	14(21.21)		
Egg size	0(00)	2(8.3)	2(9.1)	4(6.06)		
Breeding cocks					1.36	0.51 Ns
Yes	18(30)	24(40)	22(36.7)	64(35.6)		
No	42(70)	36(60)	38(63.3)	116(64.4)		
For which trait					6.077	0.05 *
Large body weight	13(72.2)[b]	20(83.3)[a]	11(50)[c]	44(68.75)		
Physical appearance	5(27.8)[b]	4(16.7)[c]	11(50)[a]	20(31.25)		
Controlled mating of chickens						

Yes	0(00)	0(00)	0(00)	0(000)			
No	60(100)	60(100)	60(100)	60(100)			
Effect of uncontrolled mating					1.48	0.48	Ns
Yes I know	6(10)	8(13.3)	4(6.7)	18(10)			
No, I don't know	54(90)	52(86.7)	56(93.3)	162(90)			

[abc] means in the row with different letters are significantly different, Ns = Not significant at *p>0.05*, N = Number of households, Na = Not available, and LS = Level of significance. Figures in the table represent frequency and percentage.

Farmer's Perception, Interest, and Current Status

There was a significant difference (*p<0.05*) among the chicken breed-rearing strata regarding the interest in the future expansion of improved breeds (Table 6). The chicken keepers that showed interest in the future expansion of exotic breeds were highest in exotic and mixed breed rearing-strata, due to the breed's egg productivity, fast age of sexual maturity, and large body weight. The farmers that showed no interest for the future expansion was highest for local breed-rearing strata, due to the breed's high feed competition, exposure to predator, and disease. Egg production, body weight, and disease resistance were the preferred traits for improved breeds [26] and improved breeds require best management, higher feed requirements, and exposure to diseases and predators [27].

Table 6: Farmer's Interest and Perception

Variables (%)		**Strata**		**X^2-test**	**P-value**	**LS**
Future interest	**Local (N=60)**	**Exotic (N=60)**	**Mixed (N=60)**	**Overall (N=180)**		
Interest in the exotic breed					14.29	0.001 *
Yes	42(70)[b]	55(91.7)[a]	55(91.7)[a]	152(84.44)		
No	18(30)[a]	5(8.3)[b]	5(8.3)[b]	28(15.56)		
Interest in rearing local breeds					2.73	0.256 Ns
Yes	36(60)	35(58.3)	43(71.7)	114(63.33)		
No	24(40)	25(41.7)	17(28.3)	66(36.67)		
Exotic breed preference					5.53	0.237 Ns
SASO	16(38.1)	23(41.8)	32(58.2)	71(46.71)		
Rhode Island Red	21(50)	25(45.5)	16(29.1)	62(40.79)		
KOEKOK	5(11.9)	7(12.7)	7(12.7)	19(12.5)		

[ab] means in the row with different letters are significantly different, Ns = Not significant at *p>0.05*, * = significant at *p<0.05*, N = Number of households, and LS = Level of significance. Figures in the table represent frequency and percentage.

The 63.33% of respondents showed interest in the local breeds due to their mothering ability, disease resistance, scavenging ability, and productivity with conditional supplementation. The local breeds are characterized by low productivity, producing small-sized eggs, broodiness, late maturity, and high mortality [12].

The SASSO, RIR (Rhode Island Red), and Koekoek were the most preferable exotic breeds. The SASSO breed was highly disseminated, and preferable due to its large body weight and the number of eggs, whereas, the Koekoek was recently disseminated, and preferable due to its adaptation, scavenging ability, egg-laying potential, and broodiness to some extent.

As observed, and stated by chicken keepers, the population of the local breed is decreasing and antagonistically that of the exotic breed is increasing. The productivity differences between breeds were forcing farmers to keep exotic breeds. If it continues in this manner, near future we will lose the local eco-types with distinctive traits. Similarly, Egg production, body weight, and adaptability were the first, second, and third traits that were preferred by farmers across all agro-ecologies [28].

Conclusion

The mean flock size/household was 13.22 chickens. Extension and purchase were the two main means to get the initial rearing stock of improved breeds, whereas, hatching and purchase for local breeds. The Fast age of sexual maturity, higher matured body weight, and higher average number of eggs/clutch/hen were recorded for the exotic breeds than local and hybrid. The time gap between clutches was highest for local breeds and using natural broody hens was the only way of hatching chicks. The high

egg productivity, fast age of egg lay, and large body weight were the main traits that drove farmers to replace and expand improved breeds, whereas, the mothering ability, disease resistance, scavenging ability, and productivity with conditional supplementation for local breeds. The higher feed requirement, exposure to predators, and disease were the factors that limited the expansion of exotic breeds, whereas, the low egg productivity and late age of egg laying for local breeds. The productivity difference between breeds forced the farmers to replace the locals with exotic breeds and caused a decrease in the local population and an increase in temperate breeds. So, if it is not terminated distinctive traits of local breeds will be lost near future. Therefore, regular feed supplementation and conservation of exploiting genes were recommended to achieve the full genetic potential of chickens and sustain the diluting genes of local breeds, respectively.

Lists of Abbreviations

P.O, post office; Kg, Kilogram; JARC, Jinka Agricultural Research Center; SPSS, Statistical Package for Social Science; SE, Standard error; LS, Level of significance; Ns, Not significant; N, number of households; Na, Not available; RIR, Rhode Island red; CSA, Central Statistical Agency; FAO, Food and Agricultural Organization and №, Number.

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Conflicts of interest

The author declares that there is no conflict of interest

Author's contribution

Mr. Elias wrote proposals, data collection, entries, analysis, manuscript writing, and editions.

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