**Table S1.** Characteristics of different broiler chicken rearing systems in Sri Lanka considered for the present study

| Observed parameter | Large scale companies | | Medium-scale farms |
| --- | --- | --- | --- |
| Closed-house system | Buy-back system |
| Production capacity | High | Low | Low |
| Number of birds per cage | >20, 000 | 1000-2000 | 500 – 2000 |
| Number of poultry houses (cages) | 3-14 | 1-3 | 1-3 |
| Personnel involved in daily monitoring | Farm manager, supervisors and line leaders | Farmer and field officer | Farmer |
| Poultry house environment | Controlled environment | Inner environment is not controlled | Inner environment is not controlled |
| Feeding and watering | Fully automated, monitored by line leader or supervisor, poultry feed is supplied by company | Manual, monitored by farmer,  poultry feed is supplied by company | Manual, monitored by farmer,  poultry feed is purchased by farmer |
| Litter material | Rice husk or wood shavings | Rice husk | Rice husk |
| Location1 | Remote, away from human habitat in Kurunegala and Gampaha districts (IL1 and WL3 agro-ecological regions) | Inside villages with close proximity to homes in Kurunegala and Gampaha districts (IL1 and WL3 agro-ecological regions) | Inside villages with close proximity to homes in Kandy district (WM2 agro-ecological region) |
| Administration of antibiotics | Supervisors and farm managers trained by the company administer antibiotics with occasional inspection by a veterinary surgeon. | Farmers administer antibiotics provided by the company under the supervision of field officers trained by the company. | Farmers makes the decisions and administer antibiotics purchased from local stores. |
| Antibiotics used for disease prevention and control | Amoxicillin, Enrofloxacin and Tylosin | Amoxicillin, Enrofloxacin and Tylosin | Oxytetracycline, Enrofloxacin and Amoxicillin |
| Number of farms used in the study | 3 (one each from company A, B and C) | 22 (15 from Company A and 7 from Company B) | 8 (independently operating farms) |
| Remarks | Monthly average meat production of company A, B and C were 1,300 MT, 960 MT and 600 MT, respectively. These three companies collectively contributed to 17 – 20 % of annual broiler meat production in the country (Livestock Statistical Bulletin 2019). Closed-house operations contribute to nearly 50% of the production of these companies. | The buy-back system contributed to nearly 50% of the production volume of the company. 10% of the buy-back farms associated with the company were sampled. Buy-Back farms receive all major inputs and services (such as chicks, feed, veterinary drugs and extension service) from the parent company and the entire production is purchased by the parent company when the birds are market ready. | These farms are operated independently without linking to major broiler chicken companies. |

1 IL, WL and WM in agroecological zones stand for Intermediate zone Low country, Wet zone Low country and Wet zone Mid country, respectively.

Table S2. Land-use history and soil characteristics of two fields with different history of broiler chicken manure (BCM) application [3 years (SH) and 10 years (LH)] selected for collecting soil samples for pot experiment.

|  |  |  |
| --- | --- | --- |
| Character | SH | LH |
| Cropping history (immediate past three crops) | Beet root, Carrot, Potato | Potato, Leeks, Carrot |
| History of broiler chicken manure application | Less than 3 years. Apply before ploughing in each season, rate: 10 tons/ha  Most recent application: 7 months before soil sampling | More than 10 years. Apply after ploughing in each season, rate: 7 tons/ha  Most recent application: 7 months before soil sampling |
| History of cattle manure application | During past ten years applied once a year  Rate: 4 truck loads/ha  Most recent application: 11 months before soil sampling | During past ten years applied only four times  Rate: 4 truck loads/ha  Most recent application: 23 months before soil sampling |
| Soil texture (Pipette method)1 | Sandy clay loam | Sandy clay loam |
| pH (1:2.5 in water) 1 | 4.84 ± 0.51 | 4.73 ± 0.5 |
| Electrical conductivity (1:5 in water) 1- dS/m | 0.37 ± 0.2 | 0.38 ± 0.2 |
| Organic carbon (Walkley and Black method) 2 - % | 2.55 ± 0.3 | 2.35 ± 0.6 |
| Active carbon (Permanganate oxidizable C) 3 – mg/kg | 399 ± 0.3 | 455 ± 0.08 |
| Potentially mineralizable nitrogen (anaerobic incubation method) 2  – g N/g dry soil/week | 22.2 ± 1.80 | 28.4 ± 1.73 |
| Soil respiration (NaOH trap method) 2  - g CO2 /g dry soil/week | 13.1 ± 1.09 | 13.1 ± 0.64 |
| Culturable aerobic bacteria (0.3% TSA medium) 2  - log10 CFU/ g dry soil | 4.71 ± 0.249 | 4.93 ± 0.066 |
| Culturable aerobic fungi (Rose Bengal Agar medium) 2  - log10 CFU/ g dry soil | 2.78 ± 0.016 | 2.85 ± 0.144 |

Note: both fields have been cultivated for more than 20 years and the cropping frequency was three crop cycles per year with less than one month interval between two crops. Lands were owned by the farmer. Both farms purchase broiler chicken litter from the same seller (sole dealer in the area) who receive it from farms in North Western Province of Sri Lanka. Sampling was done at the end of harvesting the last crop and there was no active crop in the field. Soil analyses were performed in replicates following standard protocols and values are presented as mean ± standard deviation.

1Dharmakeerthi, R.S., Indraratne, S.P. and Kumarage, D. (Ed). (2007). Special Publication No. 01, Soil Science Society of Sri Lanka.

2Methods of soil analysis. Part 2 Chemical and Microbiological Properties (2nd ed.), 1982, Agronomy series No.9, ASA, SSSA, Madison, Wis.USA.

**3**Culman, S.W., Snapp, S.S., Freeman, M.A., Schipanski, M.E., Beniston, J., Lal, R., Drinkwater, L.E., Franzluebbers, A.J., Glover, J.D., Grandy, A.S. and Lee, J., 2012. Permanganate oxidizable carbon reflects a processed soil fraction that is sensitive to management. *Soil Science Society of America Journal*, *76*(2), pp.494-504.

Table S3. Pearson’s correlation coefficient (R) for relationships between measured parameters of broiler chicken litter collected from buy-back farms operated under large-scale companies and the medium-scale farms that operated independently.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | pH | Moisture level | | Enrofloxacin resistant bacteria | | Oxytetracycline resistant bacteria | |
| Farms linked to largescale companies (n=25) | |  | | |  | |  | |
| Moisture level | | 0.31 (ns) **1** |  | |  | |  | |
| Enrofloxacin resistant bacteria | | 0.43 (0.033) | 0.12 (ns) | |  | |  | |
| Oxytetracycline resistant bacteria | | 0.61 (0.001) | 0.49 (0.013) | | 0.63 (0.001) | |  | |
| Total culturable bacteria | | 0.26 (ns) | 0.48 (0.015) | | 0.12 (ns) | | 0.24 (ns) | |
| Medium-scale farms (n=8) |  | | |  | |  | |  | |
| Oxytetracycline resistant bacteria | | NA | NA | | 0.65 (ns) | |  | |
| Total culturable bacteria | | NA**2** | NA | | -0.19 (ns) | | 0.37 (ns) | |

1 values within parenthesis indicate the probability (*P*) for the significance of correlation. Correlation is significant when *P* < 0.05; ‘ns’ denote ‘not significant’ (*P* > 0.05).

2 NA – Not analyzed because the range of pH and moisture levels were narrow.

Table S4. Summary statistics from Analysis of Variance (ANOVA) factorial analysis of total culturable and oxytetracycline resistant bacteria populations in carrot roots considering the history of manure application to soil (soil type), antibiotic input treatment (treatment) and bacteria type as the main grouping factors.

|  |  |  |  |
| --- | --- | --- | --- |
| Grouping factors1 | Mean abundance of bacteria in three different growth media (Log10 CFU/g dry soil) | | |
| TSA2 | TSA-OTC12 | TSA-OTC102 |
| Soil type |  |  |  |
| SH-Soil | 5.16 | 3.60B | 2.93 |
| LH-Soil | 5.20 | 4.02A | 3.09 |
| *P* value | 0.418 | <0.001 | 0.213 |
| Treatment |  |  |  |
| Control | 5.08B | 3.59B | 3.00AB |
| TC10 | 5.22AB | 3.76AB | 2.77B |
| TC100 | 4.98B | 3.85AB | 2.87B |
| BCL | 5.41A | 4.03A | 3.38A |
| *P* value | <0.001 | 0.005 | 0.002 |
| Bacteria type |  |  |  |
| Endophyte | 4.33B | 3.71B | 2.98 |
| Epiphyte | 5.95A | 3.90A | 3.04 |
| *P* value | <0.001 | 0.031 | 0.540 |
| Interaction effects |  | *P* value |  |
| Soil type Treatment | 0.063 | 0.190 | 0.007 |
| Soil type Bacteria type | 0.099 | 0.193 | 0.070 |
| Treatment Bacteria type | 0.699 | 0.121 | 0.714 |
| Soil Treatment Bacteria type | 0.047 | 0.167 | 0.415 |

*P* value indicates the calculated probability to test the significance of main factors and their interactions on measured dependent variables. Mean comparison was performed when the grouping factor was significant (*P*<0.05) using Tukey’s test at *P*=0.05. Means followed by the same letter in a given column under each main grouping factor are not significantly different.

1 Soil type:- 3 years history of BCL application (SH) and 10 years history of BCL application (LH); Treatment:- BCL applied at 4.5 g/kg (BCL), oxytetracycline applied at 10 mg/kg (OTC10) and 100 mg/kg (OTC100) rates and an un-amended potting mixture as the control; Bacteria type:- epiphytes and endophytes in carrot roots.

**2** TSA, TSA-OTC1 and TSA-OTC10 – Tryptic soy agar medium supplemented with 0 µg/mL, 1 µg/mL and 10 µg/mL oxytetracycline, respectively.