

Preliminary Studies on the Chemistry of Cattle Manuring on Coconut Estates

BY

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MANURING by tethering cattle on coconut estates is a well-established traditional practice in Ceylon. Whether it has a sound scientific basis or not needs careful investigation. There is no doubt that it could not have gained such popularity had it not given practical results in increasing and/or maintaining yields on coconut estates.

Cattle and other livestock on coconut estates are kept with the expectation of utilizing their excreta as a source of manure for the coconut palms. While it may be true that the ideas which estate owners had entertained with regard to the value of this practice are sometimes exaggerated it would be useful to examine the scientific basis on which these practices are founded, as well as the possibilities of rationalizing these practices in the light of the results of the manurial experiments and studies on the nutrition of coconut palm.

We cannot share the views of those who, preparing a mere balance sheet of nutrients taken up by cattle, based on insufficient data and incomplete deductions, condemn cattle manuring wholesale by the disparaging remark "Robbing Peter to pay Paul".

Cattle help to transform unavailable minerals (such as potash), held up by the soil into easily assimilable plant food. Even though added fertility can normally result from purchased manures bought from outside, cattle transfer from the pasture flora on which they graze plant food, both nitrogen and potash that would not be normally available to the coconut palm and thus add to the credit side of the manurial balance sheet in the cycle of changes that take part between the plant and the soil.

In the second place, cattle may produce an actual increase in the nitrogen content of the soil. This may be effected by the action of nitrogen-fixing bacteria, such as *Azotobacter*, for the development of which cattle manure would be the best medium.

The legume *Desmodium triflorum* that forms the main association with close grazed grasses of coconut estates, must also be fixing nitrogen, which in turn, is made available as manure through cattle.

EXPERIMENTAL

In order to determine the amount of plant nutrients produced by cattle in the traditional method of tethering a pair of animals at night and investigating into the chemistry of cattle manuring, a special cattle shed was constructed, in which 10 animals could be tethered and the dung and urine collected separately for each animal and samples obtained for analysis.

Buffaloes.—As no records of the composition of buffalo manure were available (except those of Philippine carabaos) ⁽¹⁾, the first series of analyses was carried out with one pair of working buffaloes that were separately tied in the cattle shed for a period of 10 consecutive nights, the animals being tied in the evening. The amount of dung and urine produced was collected separately for each animal every morning and samples taken for analysis. The results of this work is shown in Table Ia and B where the volumes of urine for each day for a period of 10 nights, weights of dung and composition of both dung and urine, are separately given.

On this basis, a pair of buffaloes tied for 10 nights voided 5.14 gallons of urine containing a total nitrogen content of 0.32 lb. and a total potash content of 0.86 lb. (calculated as potassium oxide).

During this period 450 lb. of dung were produced, containing an average moisture content of 81 per cent., which has a total nitrogen content of 1.06 lb. and a total potash content of 0.31 lb. (calculated as potassium oxide).

Table II shows the average composition of faeces voided by Philippine Carabaos (Buffaloes) ⁽¹⁾. The average daily yield of dung is 18.8 kg. (It may be mentioned that in this analysis, it is not known whether the dung was in contact with urine or not.) This amount presumably includes the dung voided by day and night whereas Table Ia refers to amounts voided at night.

Neat cattle.—A similar experiment was conducted on a more comprehensive scale, using 5 animals, representative of the usual type of village cattle used for manuring. The selected animals were tied at 4 p.m. each day and untied at 7 a.m. the following day for a period of 7 days. Dung and urine produced during this period were collected separately for each animal, daily records being kept for every individual animal.

For sampling, 200 c.c. of urine and 400 grm. dung were used per day per animal, and this too was done in duplicate.

Moisture determinations were made on the samples daily, the analyses being done on air dry samples. These too were done in duplicate on the samples, a moisture determination also being done in conjunction with every analysis.

The complete results were summarized in Table III, composition being calculated on air-dry samples.

Tables IV and VI show the comparative manurial values of cattle manure and buffalo manure. In Table V, results are shown, calculated on fresh excrement, in conjunction with results obtained from analyses on American ⁽²⁾, Philippine ⁽¹⁾ and Nellore cattle ⁽³⁾.

On this basis, a pair of neat cattle tied for 10 nights voided 184 lb. fresh dung or 29.4 lb. of moisture-free matter; percentage of moisture being 84 per cent. (as compared with 81 per cent. for buffalo) which gives a total—

Nitrogen value of	..	0.52 lb.
Potash value of	..	0.14 lb. (calculated as Potassium Oxide)
and a total Phosphoric Acid value of		0.25 lb. (calculated at P_2O_5).

The corresponding values of urine during this period are : 6.74 gallons of urine containing a total nitrogen value of 0.76 lb., and a total potash value of 0.99 lb. (calculated as potassium oxide).

DISCUSSION

An examination of these results indicate the inadequacy of manuring coconut palms by the traditional method of tethering cattle only, without adequate supplementary manures to form a balanced manure mixture. In the light of the results obtained from the manurial experiments conducted by us ⁽⁴⁾, ⁽⁵⁾ using mainly artificial manures, it should be pointed out that cattle manuring as done by the traditional method of tethering cattle for 7 to 10 nights alone supplies an inadequate amount of Potash to the palm compared to the high proportion of nitrogen (vide Table VI).

More recent data ⁽⁵⁾ tend to show that excess nitrogen may in fact be harmful.

The results of our manurial experiment show that, whilst nitrogen in excess of say, 0.5–0.75 lb. N. per palm, may be excessive, the corresponding amounts of potash should amount at least to 1.5 lb. K_2O , if applied biennially.

In the case of lateritic soils, poor in phosphoric acid, phosphoric acid should also be supplemented to produce an adequately balanced mixture.

In most estates where cattle manuring is done, particularly the small estates, it is the usual practice to add 1 to 2 tins of ash and this should supply both the potash and phosphoric acid to form a balanced mixture. It will therefore be seen that the traditional practices have a sound scientific basis.

Where cattle manuring is done on an extensive scale, adequate supply of ash (e.g., butt-end ash and/or husk ash or kitchen ash) cannot be economically obtained. Under such conditions the addition of supplemental artificial manures in the form of Muriate of potash (at least 1 lb.) and phosphatic manure such as saphos (at least 1 to 2 lb.), as recommended in Coconut Research Scheme Leaflet No. 12, seems justified.

In the paper entitled "The Possibilities of Ley Farming and Alternate Husbandry on Coconut Estates" ⁽⁶⁾ the writer has discussed at length the question of Animal Husbandry on Coconut Estates. It is well known that cattle (and this is particularly true of buffaloes with their active digestive system adapted to assimilate coarse fodders and weeds, such as illuk) help

to transform vegetable matter into assimilable plant food far more quickly than by the natural process of decay when such materials are turned into the soil. On the basis of a manurial balance sheet, using the animal as a factory for producing easily assimilable organic matter, there would be a quick turn-over of both the Nitrogen and the mineral matter that would not, under normal conditions, be easily available to the root system of the coconut palm.

It is not proposed to explain in detail this aspect of the subject. Suffice it to say that the traditional method of tethering cattle, which no doubt could be improved in a variety of ways, has a sound basis of scientific confirmation.

We are aware of estates where reasonable yields have been maintained by cattle manuring alone, using husk and butt-end ash on practical lines.

There are many aspects of this problem which should be investigated more closely, and as further light is thrown in the course of time, it should be possible to develop this traditional system of manuring on modern lines. We may, however, conclude that cattle (and perhaps other forms of livestock too, like goats, pigs and poultry, &c.) should form the basis for a system of scientific mixed farming on coconut estates, in order to maintain the fertility of soil.

From a system of coconut monoculture, a scientific development of animal husbandry (mixed farming) should therefore be the key to a well developed system that must break away from traditional method of cattle manuring as done on coconut estates.

ACKNOWLEDGMENTS

Thanks are due to Messrs E. Chinnarasa, Y. Ellikawela, and L. A. Fernando, formerly Technical Assistants to the Soil Chemist for, carrying out most of the earlier analyses, and to the Field Assistants of the Department of Soil Chemistry for the invaluable help given in the course of the experiment.

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TABLE IA

Composition and Volume of Buffalo Urine

Night No.	Volume of Urine in c.c.		Grm. N. per 100 c.c.		Total N. in gm.		K ₂ O gm/100 c.c.		Total K ₂ O gm.	
	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2
1	—	720	—	0.34	—	2.45	.8	—	—	—
2	840	2,620	0.85	0.53	7.14	13.89	1.98	1.10	16.63	28.82
3	270	1,060	0.78	0.55	2.11	5.83	2.12	1.25	5.72	13.25
4	950	1,000	0.60	0.59	5.70	5.90	—	—	—	—
5	1,600	2,490	0.83	0.67	13.28	16.68	—	—	—	—
6	150	410	0.73	0.60	1.10	2.46	1.68	1.48	2.52	6.07
7	1,750	1,110	0.76	0.58	13.30	6.44	1.80	1.55	31.50	17.20
8	2,270	1,650	0.70	0.56	15.89	9.24	2.03	1.75	46.08	28.80
9	470	2,010	0.64	0.50	3.01	10.05	1.90	1.82	8.93	36.58
10	240	1,770	0.54	0.50	1.30	8.85	1.51	1.58	3.62	27.97
Total	8,540	14,840			62.83	81.79			115.00	158.77
					For 10 days				For 10 days	
					Mean—0.16 lb.				Mean—0.43 lb.	

TABLE IB

Composition and Weights of Buffalo Dung

Night No.	Weight of dung in lbs.		Moisture per cent. in fresh dung		Nitrogen per cent. in Air Dry material		Potash per cent. in Air Dry material				
	1	2	1	2	1	2	1	2			
1	24.90	18.67	..	79.9	81.4	..	0.72	1.37	..	.275	.295
2	24.01	21.10	..	80.0	79.8	..	1.11	1.12	..	.416	.295
3	21.31	16.76	..	80.0	79.0	..	1.15	1.12	..	.525	.244
4	23.40	22.64	..	80.7	80.8	..	1.21	1.25	..	.436	.279
5	18.67	23.96	..	80.8	81.2	..	1.28	1.43	..	.350	.329
6	22.19	27.26	..	80.7	81.9	..	1.27	1.29	..	.379	.331
7	25.05	25.28	..	81.5	82.1	..	1.15	1.16	..	.344	.342
8	28.33	23.74	..	82.8	82.6	..	1.27	1.17	..	.248	.374
9	25.66	20.25	..	83.2	83.4	..	1.20	0.98	..	.230	.387
10	22.11	13.40	..	81.8	81.0	..	1.16	1.23	..	.294	.515
Total	235.64	21.31					11.52	12.12		3.497	3.291
Mean/day	22 lb.			81.2			1.15	1.21		0.350	0.329

TABLE II

The Average Chemical Composition of Faeces of Philippine Carabaos

Animal No.	Average daily yield kg.*	H ₂ O	N.	P ₂ O ₅	K ₂ O	CaO
9	19.9	83.1	0.22	0.65	0.17	0.20
64	19.8	83.9	0.26	0.53	0.17	0.13
83	16.9	82.4	0.27	0.76	0.11	0.18
89	15.3	82.1	0.33	0.61	0.13	0.17
122	22.0	82.6	0.28	0.58	0.14	0.19
Average	18.8	82.9	0.27	0.63	0.14	0.17

* 1 Kg. = 2.2 lb.

TABLE III

Composition of Cattle Manure

Animal No.	Production per animal per night		Composition of Excrement of Air-dry samples							
			Nitrogen		Phosphoric Acid		Potash		Moisture on dry sample	Total moisture in Dung
	Fresh Dung A	Urine e.c. B	Dung A	Urine B	Dung A	Urine B	Dung A	Urine B	per cent.	per cent.
1	7.6	1,460	1.52	1.21	0.83	T	0.25	1.04	9.8	83.9
2	6.7	1,752	1.50	1.03	0.76	R	0.29	1.22	9.2	81.3
3	6.8	813	1.43	1.21	0.75	A	0.42	1.76	10.3	83.1
4	11.8	1,260	1.83	1.10	0.65	C	0.43	1.88	9.2	84.9
5	12.8	2,392	1.81	1.12	0.69	E	0.75	1.61	8.9	86.0
Average	9.2	1,535	1.62	1.13	0.74	—	0.43	1.49	9.5	83.8

TABLE IV

Showing the comparative Manurial Values of Cattle Manure and Buffalo Manure in terms of the amount of excrement per animal per night

	Neat	Cattle	Buffaloes
<i>Urine—</i>			
1. Volume per night		1.535 e.c.	1.219 e.c.
2. Total Nitrogen per night		17.23 grm.	0.016 lb.
		or	
		0.038 lb.	
Percentage Nitrogen		1.13	0.62
3. Total Phosphoric Acid per night		Trace	Trace
Percentage Phosphoric acid			
4. Total Potash per night		22.48 grm.	0.043 lb.
		or	
		0.050 lb.	
Percentage Potash		1.49	1.68
<i>Dung—</i>			
1. Amount voided per night		9.2 lb.	22.5 lb.
2. Total Nitrogen per night		0.026 lb.	0.053 lb.
Percentage Nitrogen		1.62	1.18
3. Total Phosphoric Acid per night		0.012 lb.	
Percentage Phosphoric Acid		0.74	—
4. Total Potash per night		0.007 lb.	0.015 lb.
Percentage Potash		0.43	0.34

TABLE V

Showing the Composition of Fresh Excrement of Ceylon Neat Cattle,
American Cattle, Nellore and Philippine Cattle

<i>Animal No. (Ceylon)</i>	<i>Weight of Dung voided per night (lb.)</i>	<i>Dry Matter Percentage</i>	<i>Nitrogen Percentage</i>	<i>Phosphoric acid per- centage</i>	<i>Potash per- centage</i>
1	7.6	.. 16.1	.. 0.27	.. 0.16	.. 0.04
2	6.7	.. 18.7	.. 0.31	.. 0.16	.. 0.06
3	6.8	.. 16.9	.. 0.26	.. 0.13	.. 0.08
4	11.8	.. 15.1	.. 0.32	.. 0.11	.. 0.07
5	12.8	.. 14.0	.. 0.28	.. 0.11	.. 0.12
Average	9.2	.. 16.1	.. 0.28	.. 0.13	.. 0.07
American cattle	52.0 per day	.. 16.2	.. 0.22	.. 0.21	.. 0.16
Nellore cattle (cows)	11.6 kg. per day*	.. 17.5	.. 0.28	.. 0.30	.. 0.15
Philippine cattle (cows)	11.4 kg. per day*	.. 16.2	.. 0.27	.. 0.41	.. 0.20

* Kg. = 2.2 lb.

TABLE VI

Total manurial values of Cattle Manure and Buffalo Manure expressed
in lb. per animal per night

<i>Manurial Constituents</i>	<i>Total in lb. (per night) per animal</i>	<i>Total in lb. 10 nights per pair</i>
<i>Buffalo Manure—</i>		
1. Total Nitrogen in Dung and Urine	.. 0.069 lb.	.. 1.38
2. Total Phosphoric acid in Dung and Urine	.. not determined	.. —
3. Total Potash in Dung and Urine	.. 0.058 lb.	.. 1.16
<i>Cattle Manure, Neat—</i>		
1. Total Nitrogen in Dung and Urine	.. 0.064 lb.	.. 1.28
2. Total Phosphoric Acid in Dung and Urine	.. 0.012 lb.	.. .24
3. Total Potash in Dung and Urine ..	.. 0.057	.. 1.14