THE SOIL EROSION QUESTIONNAIRE—1935*

MALCOLM PARK, MYCOLOGIST

(ACTING SECRETARY, CENTRAL BOARD OF AGRICULTURE)

IN 1929, as a result of agitation by those interested in the agricultural welfare of the Island, a committee was appointed to consider and report on the question of soil erosion in Ceylon. The Committee, of which the Director of Agriculture was Chairman, consisted of representatives from the Ceylon Civil Service, the Forest Department, the Survey Department, the Irrigation Department and the planting community. It is generally agreed that the work of the committee was extremely thorough and the report published in 1931 an excellent one. The recommendations of the committee, embodied in Chapter V. of the report were, briefly, that the need for the extension of anti-soil erosion measures in Ceylon was great ; that much could be done by the extension of the propaganda work already carried out by the Department of Agriculture and by progressive agriculturists ; that the clearing of land by Government Departments should serve as an example to others of the correct application of methods of soil conservation ; and that, although the Committee was at first unanimously of the opinion that Government interference was called for, it felt that, until the possibilities of propaganda, persuasion and example had been exhausted, it was not desirable to recommend Government interference with private property. The report went on to say :

> " The Committee considers, however, that after educative methods have been tried for a limited period, say five years, or, if the present depression continues, seven years, the subject should be brought up for review on the understanding that, if conditions are still unsatisfactory, compulsion by means of legislation should be further considered."

The question of soil erosion was again raised at the meeting of the Central Board of Agriculture held on 13th September, 1934. After an interesting discussion the Board decided that its Executive Committee should go into the question and consider ways and means of implementing partly or wholly the recommendations made in Chapter V. of the Report of the Soil Erosion Committee.

The Executive Committee considered the matter at a meeting held in November, 1934 and decided that before recommendations could be framed it was desirable that data should be obtained to show what progress with measures of soil conservation had been made since the publication of the Report of the Soil Erosion Committee. To this end a circular letter was

*The above is a revision of the article which appeared in this Journal, Vol. LXXXV, No. 6, Dec., 1935, pp. 369-380.—*Ed.* T. A.

sent to the Planters' Associations and to other organizations interested in agriculture asking for information. The answers to this circular letter proved to be unsatisfactory and a questionnaire was drawn up. Details of the questionnaire are given below :

SOIL EROSION QUESTIONNAIRE

1. Name of Estate :

2. Planting District :

			Acres
3. Acreage under	(i) Tea	.. .. ..	
	(ii) Rubber	.. .. ..	
	(iii) Coconuts	.. .. ..	
		Total ..	

4. (*A*) Anti-soil erosion Measures taken :	On old areas				
	Prior to 1931	Measures taken in 1931	1932	1933	1934
(*a*) Drains.—					
(i) Level, contour or regraded drains ..					
(ii) Lock and spill drains ..					
(iii) Reverse slope drains ..					
(*b*) Silt-pits ..					
(*c*) Contour terraces ..					
(*d*) Contour platforms					
(*e*) Contour planting (*i.e.*, of the crop)					
(*f*) Contour hedges of green manure plants ..					
(*g*) High shade ..					
(*h*) Low shade ..					
(*i*) Ground cover crops ..					

(i) Introduced (not naturally occurring).
(ii) Naturally occurring (including weeds and grasses)

4. (*B*) Same questions as above, for new clearings (opened since 1930)

5. Do stray cattle cause any damage to ground cover crops on the estate ?

6. Do you still use scrapers ?

Copies of the questionnaire were sent to about 1,200 estates, through the courtesy of the Planters' Association of Ceylon and of the Low-Country Products' Association, to the Tea Research Institute, the Rubber Research Scheme, the Coconut Research Scheme and to the six Divisional Agricultural Officers of the Department of Agriculture. Where more than one crop was grown on an estate, superintendents were asked to use a separate form for each crop, provided that the extent exceeded ten acres. Approximately 1,000 completed forms were received.

In analysing the answers to the questions certain difficulties were at once apparent. The total areas on which soil conservation measures had been undertaken were not always given. It is a common practice on estates to lay down more than one soil conservation measure on the same land ; for example, contour hedges of green manure plants are often planted in conjunction with contour drains. It was therefore sometimes possible when analysing returns to obtain only an estimated figure for the total area treated, but it is thought that errors so introduced are not great.

Drains.—The figures given for the area under level, contour or regraded drains (Question 4(*a*) (i)), must be accepted with a certain amount of reserve. The term " contour drains " has, unfortunately, not been taken literally by all who have answered the questionnaire as it is customary for some planters to refer loosely to any lateral drains, which may have a slope of 1 in 30, as contour drains. It was found impossible to delete every answer in which this mistake was made, although this was done when it was clear from personal knowledge that a mistake had been made.

The answers to questions 4(*a*) (ii) and 4(*a*) (iii) are probably correct as the terms are well understood.

Silt pits.—It was the intention, when the questionnaire was framed, to obtain figures for the area in which were dug adequate silt pits such as those of the type known as Java silt pits, which are shown in Fig. 17 of the Report of the Soil Erosion Committee. The answers to the questionnaire indicated that this interpretation had not been adhered to and, as it was felt that many of the silt pits classified have but little value as measures for soil conservation, the answers to this question have not been included in the summaries which are now printed. Moreover, in measures such as lock and spill drains and contour platforms silt pits play an integral part and it was felt that an unnecessary duplication of figures might lead to a fictitious appreciation of the situation.

Contour terraces, platforms, planting and hedges of green manure plants.—The answers to questions 4(*c*), 4(*d*), 4(*e*) and 4(*f*) appear to have presented no difficulty and have been accepted as received.

TABLE I

TEA

Planting District	No. of Ests.	Total Area	Measures Taken				No. of Ests. damaged by Cattle	No. of Ests. using Scrapers
			Before 1931	Since 1931				
			Old Areas	Old Areas		New Clearings		
				New Work	Superimposed			
		Acres	Acres	Acres	Acres	Acres		
Alagalla	5	1,670	1,260	5	—	5	—	3
Ambegamuwa	8	3,576½	1,777¼	564½	—	66	2	8
Badulla	37	25,116¼	15,417	2,631	1,210	269	10	29
Balangoda	10	5,038¼	2,667	1,081	—	476¾	3	9
Bandarawela	1	298	35	263	—	—	1	—
Dickoya, Lower	1	606	594	—	540	12	—	1
Dickoya	60	19,778	12,747½	5,808½	4,290¾	20½	1	48
Dimbula	78	35,801¼	17,546¼	7,263	2,854½	160½	3	62
Dolosbage	16	7,854½	3,765¾	1,360¾	105	119¾	3	14
Galagedera	1	190	3	183	—	—	—	1
Galle	8	2,439½	1,751¾	—	50	125	2	5
Galaway, New	2	826	826	—	44	—	—	1
Hantane	8	4,367½	1,195	1,456½	—	2½	—	8
Haputale	29	18,358½	9,888½	2,308½	1,343½	84½	1	20
Haputale, West	2	451	451	—	—	—	—	2
Hewaheta	8	6,085	3,530½	427¾	614	40½	4	7
Hewaheta, Upper	1	928½	—	928½	—	—	—	1
Hewaheta, Lower	1	914	—	—	—	25	—	1
Hunasgiriya	5	3,289¼	769	1,256	—	136	2	4
Kadugannawa	6	1,881¾	1,696¼	—	—	4½	—	6
Kandy	5	1,592	1,494	16	—	—	1	5
Kalutara	10	4,243¾	2,878	131	—	34	2	6
Kegalle	7	3,013¼	2,378	14½	200	95½	2	6
Kelani Valley	9	3,020¾	1,242¾	58	200	78½	5	5
Kelabokke	7	3,837½	1,871	597½	—	4½	—	7
Knuckles	10	5,067½	4,073½	599½	493	—	2	9
Kotmale	8	5,518½	775	1,092	—	155	—	8
Kurunegala	1	200	82	—	—	—	—	—
Madulsima	9	8,045¾	4,766	1,035	—	195	—	7
Maskeliya	33	15,186	4,467	2,997	469	27	—	28
Matale, East	14	5,541¾	2,446	1,179	772	26½	3	13
Matale, North	4	948¼	235¼	503	—	17¾	3	2
Matale, South	8	2,662¾	1,615½	—	—	30	2	7
Matale, West	2	1,079	52	548	—	64	—	2
Matara	1	728	—	—	—	—	—	1
Maturata	10	6,022	893	1,843½	—	11½	—	9
Medamahanuwara	2	778	45	82	—	14	1	2
Moneragalla	1	348	—	348	—	—	—	1
Morawak Korale	8	3,397½	1,751	790½	60	207	1	7
Nilambe	8	4,499	462	715	83½	81½	—	7
Nuwara Eliya	11	4,616¼	975¾	2,169½	—	46	2	7
Passara	6	6,487¾	2,585	1,405½	—	44½	2	6
Pundaluoya	6	3,496	2,553	25	—	3	—	3
Pussellawa	17	10,213¾	6,168	820½	—	200¾	5	17
Rakwana	9	3,909	2,699½	591½	559½	—	3	9
Ramboda	7	5,591¾	1,860	1,021	—	75½	—	7
Rangalla	6	5,005¾	3,241½	532	1,091	—	1	6
Ratnapura	26	19,577¾	10,008	2,420	170	315	7	16
Uda Pussellawa	21	10,955½	5,573	3,028½	—	165½	3	12
Wattegama	4	1,908¼	1,004¾	912	—	91	—	6
Yakdessa	1	507	—	—	—	—	—	1
	558	287,467¾	144,116¼	51,012	15,149¾	3,530½	77 (13·8%)	452 (81%)

TABLE 2

RUBBER

Planting District	No. of Ests.	Total Area	Measures Taken				No. of Ests. damaged by Cattle	No. of Ests. using Scrapers
			Before 1931	Since 1931				
			Old Areas	Old Areas		New Clearings		
				New Work	Superimposed			
		Acres	Acres	Acres	Acres	Acres		
Allagalla	4	1,278½	908½	370	87	—	2	—
Ambegamuwa	1	310½	310½	—	—	—	1	—
Badulla	9	726¼	667¼	—	—	—	1	4
Balangoda	2	227	227	—	—	—	2	2
Colombo	1	273	273	—	—	—	1	1
Dolosbage	8	995¾	610¾	25	—	—	4	3
Dumbara	2	551	—	—	—	—	—	—
Elpitiya	1	525	523	—	—	2	1	—
Galagedara	2	613	400	—	—	—	1	—
Galle	27	15,233½	14,945½	203	482	10	17	3
Hantane	3	430½	—	—	—	—	1	—
Haputale	12	3,736¼	2,030¾	655	250	10	6	1
Hewaheta	1	44	44	—	—	—	1	1
Kadugannawa	5	1,849	874	—	42	—	1	1
Kandy	4	1,042	1,042	—	—	—	1	—
Kalutara	62	37,076¼	32,450	4½	1,666	550½	48	10
Kegalle	26	11,347½	9,273¾	28	—	151	15	3
Kelani Valley	66	38,833½	32,425¼	1,685½	—	354½	57	6
Kelabokke	1	10	—	—	—	—	—	—
Knuckles	3	389½	389½	—	25	—	2	2
Kotmale	2	614½	360½	—	—	—	—	—
Kurunegala	9	4,693¾	2,213½	251	—	224	6	—
Madulsima	3	193	162	—	—	—	—	1
Matale, East	8	2,820	2,427	370	—	8	3	1
Matale, North	10	5,517¾	4,410	589	—	23¾	8	4
Matale, South	10	2,584	1,701	220	—	—	4	4
Matale, West	15	7,496½	5,737½	531	—	4	13	7
Matara	2	1,123	793	—	—	—	1	2
Medamahanuwara	5	2,831	2,247	—	—	—	—	2
Morawak Korale	6	961	675	—	400	—	—	1
Nilambe	4	481	721	—	—	—	—	—
Passara	5	1,820	1,590¼	—	—	—	3	2
Pussellawa	7	767½	465½	—	—	—	2	3
Rakwana	6	1,654	1,082	115	—	—	3	1
Rangalla	2	278	278	—	—	—	2	1
Ratnapura	40	26,510	20,085	—	151	38	28	12
Wattegama	6	1,229¾	700	50	—	—	1	2
Yakdessa	2	952	366	—	—	—	—	1
	382	178,018¾	143,409¼	5,097	3,103	1,375¾	236 (61·8%)	81 (21%)

TABLE 3

COCONUTS

Planting District	No. of Ests.	Total Area	MEASURES TAKEN					
			Before 1931	Since 1931			No. of Ests. damaged by Cattle	No. of Ests. using Scrapers
			Old Areas	Old Areas		New Clearings		
				New Work	Super-imposed			
		Acres	Acres	Acres	Acres	Acres		
Chilaw	7	3,356	2,106	354	—	—	5	—
Colombo	1	299	299	—	—	—	1	1
Galle	1	887	887	—	346	—	—	1
Hewaheta, Upper	1	38½	—	38½	—	—	1	1
Hewaheta, Lower	1	393½	—	—	—	—	—	—
Kurunegala	13	7,202¼	4,014½	2,074½	51	34½	7	—
Matale, South	1	14	14	—	—	—	—	1
Matale, West	1	13¾	8	—	—	—	1	1
Negombo	3	815½	484	100	—	—	—	—
Nuwara Eliya	1	628	—	627	—	—	—	—
Puttalam	1	259½	—	—	—	—	—	—
Ratnapura	1	12	10	—	—	2	1	1
	32	13,919	7,822½	3,194	397	36½	16 (50%)	6 (18·75%)

Shade.—The growth of high and low shade on estates is not undertaken as a measure of soil conservation nor does the presence of such trees, unless very thickly planted, affect to any great extent the amount of soil erosion. These figures were therefore omitted.

Ground cover.—Questions (*i*) (i) and (*i*) (ii) offered no difficulty.

TABULATION OF RESULTS

The printed questionnaires were circulated in August, 1935. By the middle of October very few further replies were being received and the tabulation of answers was commenced. The answers for tea, rubber and coconuts were separated, grouped under planting districts for convenience and the details of each estate noted. It is not proposed to give here the full details of the tabulated replies from each estate owing to lack of space. The full details are available for inspection if required, the names of estates being substituted by serial numbers as a desire has been expressed that the names of estates which have supplied information should not be disclosed.

Tables 1, 2 and 3 give summaries, for tea, rubber and coconut estates respectively, of the areas of soil conservation measures undertaken, tabulated by districts. The soil conservation measures taken have been divided up into work undertaken before 1931, new work on old areas, super-imposed work on old areas, *i.e.*, where an additional measure has been introduced since 1931 into land already possessing at least one measure, and work on new clearings. One regrettable feature of the questionnaire is that provision was not made for determining the total area of new clearings. Judging by inspection of returns, however, it would appear that all new clearings in tea, rubber and coconut have been opened with at least one soil conservation measure adopted. The last two columns of these tables show the number of estates which report damage to ground cover crops by stray cattle and those which are still using scrapers for weeding.

Tables 4, 5 and 6 are summaries, for tea, rubber and coconut estates respectively, of the total areas under the different types of soil conservation measures. These indicate what progress has been made in the extension of soil conservation since the publication of the Report of the Soil Erosion Committee.

DISCUSSION

It is not proposed to discuss fully the import of the figures given in the tables which are now published, since the matter is, so to speak, *sub judice* in that the Executive Committee of the Central Board of Agriculture are at present considering the question and their recommendations may be affected by the method in which the figures are interpreted. It is felt, however, that certain general observations may not be out of place.

The financial depression, which was alleviated only in 1934, must be taken into consideration when the figures are reviewed. However much the importance of laying down additional measures of soil conservation was appreciated by agriculturists as a result of the Soil Erosion Committee's report, the financial stringency was such that most estates were unable to spend much money on new works during the period 1931-1934. The Soil

TABLE 4

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN TEA ESTATES

1. No. of Estates submitting returns 558*
2. Acreage of Estates submitting returns 287,467¾
3. Acreage of anti-soil erosion measures taken :—

	No. of Estates	Measures taken in					Total 1931-34	Grand Total
		Prior to 1931	1931	1932	1933	1934		
Drains :	370							
(i). Level, contour or regraded ..		90,025	7,951	2,432	2,191½	15,090¾	27,665¼	117,690¼
(ii). Lock and Spill		51,479	5,866¼	2,188¾	2,398¼	9,365¾	19,819	71,298
(iii). Reverse Slope		12,352¾	1,941	2,838½	2,242	2,968¾	9,990¼	22,343
Contour Terraces		33,413¼	4,623	2,966¾	2,079½	4,590	14,259¼	47,672½
Contour Platforms	279	1,814	601½	52	164½	440	1,258	3,072
Contour Hedges		10,242½	2,367	2,039½	2,336	4,188¼	10,930¾	21,173¼
Contour Planting	25	4,193½	108	39	37	22	206	4,399½
Ground Cover :	226							
(i). Introduced		11,838½	3,679½	3,895¾	3,572	6,849	17,996¼	29,834¾
(ii). Natural		23,530¾	3,509	1,898	1,833½	2,724	9,964½	33,495¼
	900*	238,889¼	30,646¼	18,350¼	16,854¼	46,238½	112,089¼	350,978½

*The comparison of these figures indicates that a number of tea estates adopt more than one anti-soil erosion measure.—Ed. T.A.

TABLE 5

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN RUBBER ESTATES

1. No. of Estates submitting returns 382*
2. Acreage of Estates submitting returns 178,018¾
3. Acreage of anti-soil erosion measures taken :

	No. of Estates	Prior to 1931	Measures taken in 1931	1932	1933	1934	Total 1931-34	Grand Total
Drains :	219							
(i). Level, contour or regraded ..		75,081¾	492	134	67	558½	1,251½	76,333¼
(ii). Lock and Spill		3,538	202	438	571½	1,502	2,713½	6,251½
(iii). Reverse Slope		3,055½	516	297	223	796	1,832	4,887½
Contour Terraces		73,661¾	195	180	86	105½	566½	74,228¼
Contour Platforms	189	859½	95¾	78	30	165	368¾	1,228¼
Contour Hedges		4,412	900	165	41	50½	1,156½	5,568½
Contour Planting	25	3,560¾	92	92¼	71¾	68¼	324¼	3,885
Ground Cover:	292							
(i). Introduced		88,476½	1,064¼	1,386	1,141½	5,334½	8,926¼	97,402¾
(ii). Natural		20,450¼	2,090¾	740	54½	2,854	5,739¼	26,189½
	725*	273,096	5,647¾	3,510¼	2,286¼	11,434¼	22,878½	295,974½

*The comparison of these figures indicates that a number of rubber estates adopt more than one anti-soil erosion measure.—Ed. T.A.

TABLE 6

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN COCONUT ESTATES

1. No. of Estates submitting returns 32*
2. Acreage of Estates submitting returns 13,919
3. Acreage of anti-soil erosion measures taken :

	No. of Estates	Prior to 1931	Measures taken in 1931	1932	1933	1934	Total 1931-34	Grand Total
Drains :	10							
(i). Level, contour or regraded ..		2,047	62	105	75	100	342	2,389
(ii). Lock and Spill		14	52	63	81	114½	310½	324½
(iii). Reverse Slope		—	—	5	10	15	30	30
Contour Terraces		69	63	68	113½	107	351½	420½
Contour Platforms	5	201	—	—	—	—	—	201
Contour Hedges		—	113	84	164¼	144½	506	506
Contour Planting	1	80	—	—	20	—	20	100
Ground Cover:	19							
(i). Introduced		4,907	1,232	595	515½	149	2,491½	7,398½
(ii). Natural		1,098¾	—	2	107½	—	109½	1,208¼
	35*	8,416¾	1,522	922	1,087	630	4,161	12,577¾

*The comparison of these figures indicates that very few coconut estates adopt more than one anti-soil erosion measures.—Ed. T.A.

Erosion Committee appreciated this when suggesting that a period of seven years should elapse, if the depression continued, before the subject should be brought up for review.

The total areas of tea in Ceylon excluding small-holdings, has been estimated at 450,000 acres. The acreage of estates from which returns have been tabulated is 287,467¾ or about 64 per cent. of that total. The total area of estate rubber has been estimated in the Year Book of the Planters' Association for 1934, as 466,679 acres. The area from which figures have been received is 178,018¾ acres—about 38 per cent. of the total. Returns from coconut estates were received covering only 13,919 acres, which is only about 1¼ per cent. of the estimated total area (1,100,000 acres) of coconuts in Ceylon, but the area of estates is much smaller than the total area.

Tea.—In examining the figures for tea, given in tables 1 and 4, we find that, of the 287,000 acres from which figures were obtained, 144,000 acres were under one or more soil conservation measures before 1931. Since then new measures have been adopted on about 70,000 acres, but much of this area is land on which one or more soil conservation measure already existed. 452 out of the 558 estates submitting returns still use scrapers to a greater or lesser extent.

Of individual measures, the provision of soil cover is the most important. The Soil Erosion Committee stated that " the first and most important step in the control of present erosion and the prevention of future erosion is the provision of ground cover." It is noted that before 1931, 11,838½ acres of tea were planted with an introduced cover crop. Since then, approximately 18,000 acres have been planted with cover crops of which 6,849 acres were planted in 1934. Similarly, natural cover was allowed to grow in 23,530¾ acres of tea before 1931 and that area has increased by 9,964 acres between 1931 and 1934. It would appear that clean weeding is still the most common practice but that the practice of growing some form of soil cover is gaining ground.

Apart from those for new clearings, which have been affected by restriction, the figures for every measure introduced show an increase in 1934 over those for the years 1931 to 1933.

Rubber.—In considering the figures from rubber estates, is is necessary to remember that many estates have been on a " care and maintenance " basis during the period under review. In 1930, 143,000 acres of the 178,000 acres dealt with were under one or more soil conservation measures. Since then new measures have been taken on 9,500 acres, some of which are on areas on which one or more soil conservation measures already existed.

It is noteworthy that 236 out of 382 estates submitting returns report that stray cattle cause damage to cover crops.

Turning to individual measures (table 5), it will be seen that cover crops had been introduced on 88,000 acres in 1930, and that a further 9,000 acres have been planted with covers since 1930. Natural covers existed on 20,000 acres in 1930 and have been allowed to grow on about 5,700 acres more since. Adding these figures together a total is obtained of 120,000 acres under some

form of soil cover, out of the 178,000 acres of rubber from which returns were received.

Coconuts.—The percentage of estates submitting returns is so small that it would appear to be unwise to draw conclusions from them. Speaking generally, coconuts are planted on much flatter land than either tea or rubber and soil erosion is, in consequence, less rapid. Moreover, it is a common practice to allow or to encourage some sort of soil cover to grow under coconuts and this practice tends to minimise the danger of excessive soil erosion.

ACKNOWLEDGMENT

The writer wishes to acknowledge his appreciation of the assistance rendered by Mr. S. K. Thuraisingham, B.Sc., Technical Assistant, Department of Agriculture, in preparing the tables.