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Vol. CIX – No. 4 October to December, 1953

Contents

Editorial

Original Articles

Departmental Notes

Book Review

Research Notes

Meetings

Notifications

Returns

EDITORIAL

The Milk Board

THE recent enactment of the Milk Board Act marks the beginning of a new era in the chequered progress of the dairy industry of the Island and portends well for its future. It is well-known that the consumption of milk in the country is deplorably low and considerably below the requirements of minimum nutritional standards. The reason for this is mainly the absence of a well-organized dairy industry, resulting in the low production and high price of milk, its unreliable quality, adulteration being common, and the lack of adequate facilities for the collection and distribution of even the comparatively small amount of milk produced. Low consumption is also due to prejudice against its use in the diet of many village communities. This prejudice is, however, being rapidly counteracted by the health and education authorities, and through the operation, since 1944, of milk-feeding centres all over the Island where free milk is distributed to pre-school children.

It should, however, be pointed out that efforts have been made in recent years to promote the production and marketing of milk both by co-operative societies and by private dairymen. Following on the publication in 1944 of the valuable report of the Milk Committee appointed by the Minister of Health under the Chairmanship of Dr. W. G. Wickremasinghe, the then Director of Medical and Sanitary Services, and the inauguration of a network of milk-feeding centres, a stimulus was given to the formation of additional co-operative dairy societies, only a few of which were then in existence. These societies were formed for the purpose of securing marketing facilities and a fair price for the milk produced by their members. Subsequently, Co-operative Milk Unions were established in Colombo and Jaffna with the object of promoting the interests of the co-operative dairy societies and, at the same time, of making available to the consumer milk at a reasonable price. The Colombo Co-operative Milk Union now supplies about 7,000 pints of milk a day to institutions and private individuals in the city at the popular price of 55 cents per pint. With the assistance of Government, it is now engaged in erecting a Central Depot where modern dairy equipment for the collection, testing, processing, and distribution of milk will be installed. Meantime, the 52 registered Colombo dairies continue to furnish the major quantity of the city's milk supply, though the owners have been advised that their removal from the city has now become necessary.

The Department of Agriculture has also played its part in the milk production drive in the country by contributing substantially to the milk supplies of hospitals and milk-feeding centres. Last year over 420,000 gallons of cow milk and 110,000 gallons of buffalo milk were supplied from our farms at rates varying from 35 cents to 52½ cents per pint. It has also organized Livestock Production

Societies in various parts of the country to foster the production of milk and other livestock products. Recently it has initiated a scheme for the marketing of milk produced by villagers in the Tamankaduwa District. Under this scheme milk is bought from producers at a price of 25 cents per pint at collecting centres in the village—a figure perhaps twice that obtained by them previously—tested, bulked, pasteurized, and railed to the Colombo Co-operative Depot for distribution.

A few private individuals and Companies have also established dairy farms with commendable enterprise, and are thereby adding to the supplies of good milk in the country. On some coconut estates, many of which are particularly suited for dairy farming, milch cattle are kept; but more frequently than not the milk has to be disposed of at very low prices locally because of a lack of transport facilities. Without, therefore, an authority that would hold itself responsible for organizing milk production and marketing on a national scale, there could at best be only a very limited and sporadic increase in the supplies of the commodity, for two of the greatest incentives to production are an assured outlet and an economic price to the producer. This was the view of the Wickremasinghe Milk Committee, which accordingly strongly recommended the creation of a Milk Board.

A similar situation in regard to milk supplies existed in the city of Bombay before 1944. This was pointedly referred to in the reports of Mr. R. A. Pepperall, Secretary, Milk Marketing Board, U. K. in 1944 on " The Dairy Industry of India " and Mr. D. N. Khurody, Milk Commissioner, Bombay in 1940 on the " Marketing of Milk in India and Burma ". As a result of these reports, what is now popularly known as the Bombay Milk Scheme was finally inaugurated in 1949 though a start had been made in 1945. The Aarey Milk Colony has shown what planned action, strongly backed by authority, can achieve in the field of milk production. The Bombay scheme now handles over 30,000 gallons of milk a day, which it distributes in the city and suburbs from more than 700 centres.

Reverting to the subject of the establishment of a Milk Board in Ceylon, it should be mentioned that the idea found favour with the then Minister dealing with the question, but, owing to changes in Government personnel and more pressing matters requiring its attention, the bill was only recently presented to Parliament. It is gratifying to record that it received the fullest support of all sections of both Houses. The bill is " designed to establish a Board to carry out the task of regulating the production and marketing of milk by (*a*) establishing Milk Production Centres, (*b*) organizing Milk Distribution Centres, (*c*) fixing legal standards of milk, (*d*) the control of prices, (*e*) supervising the conditions under which milk is produced in order to guarantee its purity, and (*f*) generally granting effective assistance for the organization of the milk production and distribution services by local bodies, co-operative societies, &c." Owing to its fundamental importance the bill is reproduced in full in this issue of *The Tropical Agriculturist* and calls for careful study by all those connected in any way with the dairy industry. It is all-comprehensive in its content and scope, and lays a firm foundation for the establishment of a vigorous and *prosperous national* industry—*national* because of its

far-reaching effects on the health and well-being of the younger generation of Ceylonese, and *prosperous* because dairy farming undertaken on sound lines cannot but be productive of profits if organized marketing facilities are provided.

The task awaiting the members of the Milk Board shortly to be formed will be no light one, but they could rest assured that in this they would receive the fullest support and co-operation of all the authorities concerned and of every patriotic citizen of Lanka.

CORRECTION

Page 37 of *The Tropical Agriculturist*—January-March, 1953—

" 0.04% gamma BHC " *to be substituted by* " 0.24% gamma BHC ".

Dairy Economy in Ceylon under Present Conditions of Production

A. V. ANKER-LADEFOGED

Introduction

AS a rule nobody would or could be expected to take up any business enterprise which is not likely to be an economically sound commercial undertaking. Therefore when considering the insignificant role played by the dairy industry in this country one might in the first instance come to the conclusion that this is mainly due to the fact that milk production is not economic under prevailing conditions, as otherwise more activity in this field of agriculture should be expected. But if one goes a step further and compares conditions for milk production here with those found in some of the more advanced dairy countries, it would be found that there is enough evidence to show that dairying could be made a good way of earning a living if properly organized and integrated with other agricultural activities.

The desirability of developing a dairy industry in the country cannot be questioned. From a national point of view such a development is not only fully justified, but also very essential in order to meet the very severe shortage of liquid milk and dairy products in the human diet, and also because the fertility of Ceylon's soils cannot be maintained if livestock, especially cattle and buffaloes, are not more incorporated into the present system of farming. There are more reasons which could be mentioned all favouring the development of this industry and mixed systems of farming, but I shall in this paper confine myself to the more commercial aspects of milk production and thereby, I hope, help to convince the individual farmers that, viewed from their stand point, this industry is economically fully justified.

It is well known that there are several adverse conditions in this country, which tend to discourage the development of dairying. First of all there is the fact that the climatic conditions in Ceylon as a whole are unfavourable for the maintenance of high yielding pure-bred stock of European breeds and secondly that the indigenous cattle and buffalo population are extremely poor producers. Many failures have been experienced in tropical countries, including Ceylon, where attempts have been made to transplant high-producing European stock, and particularly specialized dairy stock, to areas where the environmental conditions differ materially from those in their native home or from other places where they have performed satisfactorily. In recent years, however, the superior heat-regulating ability of Zebu cattle has been fully realized and the trends in most tropical countries is now to utilize Zebu cattle or cross-bred stock, the latter having been found to be intermediate in respect of tolerance to tropical environments.

It will take several decades of work before the average level of production from Zebu cattle and crossbreds will reach standards comparable to those in advanced dairy countries where European stock are kept, but there is evidence that it will be the only way by which the problem can be efficiently and economically tackled. The Department of Agriculture

has already initiated breeding programmes on these lines and one farm is devoted especially to the improvement of the local Sinhala cattle. These breeding programmes and experiments will not only provide useful data for the formulation of the Island's long-term breeding policy, but will also be a valuable contribution to livestock work in the tropics in general.

Cattle breeding, however, is a very slow process and the improvements indicated cannot be expected to solve *to-day's* problem of milk production. In this connection it should be remembered, that while the importance of carefully-planned breeding cannot be over emphasized, the nutritional aspects of dairy cattle are equally important and in this field breeders of cattle and buffaloes in Ceylon would be able to bring about vast and immediate improvements. The position to-day is that not only is there a very small proportion of the cow population utilized for milk production, but the majority of the animals are not looked after at all. Those looked after well are nurtured to a large extent on purchased foods which naturally must result in a high cost of production. Cattle breeders are now fortunate in that good stud bulls are available and a general improvement of the cattle population need not be very far off if use is made of these bulls, and these alone. But this will result in no improvement in regard to productivity if the general level of feeding throughout the country is not going to be very considerably improved.

Although the present rather poor stock available will effect the economics of dairying to a great extent and thus causes a further obstacle to those who embark on milk production as a business enterprise, it should not prevent people with initiative making an economic success of it. The cattle breeders in this country should not merely sit back and wait for better animals, but along with improvement of stock make full use of existing facilities for milk production. In regard to the more specialized dairies, there is a good number of stock available (mainly crossbreds) which could be used for this purpose and this type of stock could rapidly be increased if dairy owners would bring to a stop the enormous wastage of calf life which at present is far too common. In regard to rural areas cattle are numerous in nearly all Ceylon villages, yet it is the rare exception to see a cow being milked. A common explanation for this is that the cows available give so little milk that they are not worth milking, but this explanation cannot be accepted in general as many of these cows with better care and proper feeding could yield a quantity of milk which would be sufficient for most families.

Economic Problems

Turning to the actual problems of economy the factors deciding the final result of production are—

(1) Demand and price of milk and surplus stock.

(2) Cost of production, inclusive of replacement of herds.

Mention has already been made of the fact that there is a ready demand for milk of good quality, or rather a severe shortage, and this is likely to be so for many years ahead. As regards the price of milk a good deal of variation exists throughout the country—the

maximum prices being paid in urban areas, particularly in the Colombo area, and the lowest in rural districts where very little milk is produced and the marketing has not yet been organized to any extent. For the country as a whole, a price varying from 35-40 cents per pint (Rs. 2.80-Rs. 3.20 per gallon) for non-pasteurised milk of good quality, may be considered as representing the price most producers would be able to obtain. When compared with prices paid for milk to producers in other countries it is evident that the above price is very favourable:

	Rs. c.	
Price per gallon in Ceylon	3 20	approx.
,, ,, ,, U. K.	1 45	,,
,, ,, ,, Sweden	1 35	,,
,, ,, ,, Australia	1 30	,,
,, ,, ,, South Africa ..	1 15	,,
,, ,, ,, U. S. A.	1 65	,,
,, ,, ,, Denmark	1 28	,,

On the average, producers in Ceylon are paid two and a half times as much as in the above mentioned countries which may be considered representative of some dairy regions.

While the disposal of milk is entirely a problem of getting the marketing facilities, &c., developed, the position in regard to disposal of surplus stock is different. The demand for meat of cattle and buffaloes is very limited and the prices which can be obtained for culled cows, undesirable male stock, and such animals which have passed their productive period are therefore very low, compared with prices paid in some countries with a developed dairy industry. This disadvantage, however, is to some extent counteracted by the fact that in Ceylon a fairly good demand exists for draught bullocks and buffalo males for paddy cultivation, unlike in the other countries mentioned.

		Rs. c.	
Average price for beef in Ceylon	= approximately	0 27	per lb. live weight
,, ,, ,, ,, U. S. A.	= ,,	0 95	,, ,,
,, ,, ,, ,, Denmark	= ,,	0 72	,, ,,
,, ,, ,, ,, U. K.	= ,,	0 80	,, ,,

There is practically no market for veal or meat of extra good quality in Ceylon and no system of grading meat has been introduced as a consequence thereof. It will be seen from the above list of prices that in the other countries prices of beef are so high that culled cows and old animals can normally be disposed of at prices which bring in enough money to pay for their replacement, or at least a very good part of this cost, whereas in Ceylon this is not the case. The dairy farmer in this country is therefore faced with another drawback in his economy to which more mention will be made under " replacement cost ". There is yet another income which arises from dairying: cattle manure, the value of which is difficult to assess as it is only in rare cases that it is sold from dairy farms. Cattle manure has a special high value on such farms where, besides dairying, intensive systems

of agricultural production are adopted. Just as the utilization of nourishing foods by live-stock has become a matter of prime importance, so the question of fertilizing the soil by animal manure has become a fundamental problem.

Factors Determining Cost of Production

The cost of production on broad lines is determined by the following:—

(1) *Level of production or average production per cow.*

(2) *Intensity of feeding and food costs, viz. :—*

(*a*) *home-grown foods,*

(*b*) *purchased foods.*

(3) *Cost of labour.*

(4) *Cost of replacement (including wastage by death).*

(5) *Overhead and miscellaneous costs.*

High average production per cow in a herd tends to increase the profit as good cows are more economic converters of feeding stuffs into milk than low yielders. This is because a very considerable part of the food consumed by dairy stock is utilized for body maintenance, heat production, &c., and this requirement for maintenance varies only according to body size, but is the same for low and high yielding cows. This therefore means that each unit of milk produced from a high producer will be cheaper than the unit produced by low yielders. For instance for a cow producing about 250 gallons of milk with 4 per cent. fat in a year only about 35 per cent. of the ration will actually be utilized for milk production while the other 65 per cent. of the ration will be used for maintaining her body ; whereas the figures for a cow producing about 850 gallons of milk per year of the same quality would be approximately 65 per cent. and 35 per cent. respectively. The figures given below clearly illustrate the greater economy derived at by an increased production per cow.

Cows (same live weight 1,100 lb.)	*I*	*II*	*III*	*IV*	*V*
Milk production per year in lb. . .	4,400	6,600	8,800	11,000	13,200
Food units fed per year . .	2,100	2,500	2,900	3,300	3,700
Milk production per food unit . .	2·09	2·64	3·03	3·34	3·56
Increase in return per food unit	—	0·55	0·39	0·31	0·22

(By Nannenson Sweden)

The figures demonstrate how the production of milk per food unit fed increases from 2.09 to 3.56 lb., it is, therefore, quite evident that it is much more economical to keep very good cows than low-producing ones, but this, however, does not of necessity mean

that low producers are always uneconomical animals to keep. Whether it will pay or not to keep cows of a low level of production is entirely determined by the conditions of production in the particular area or country. Most of the milking cows available in Ceylon would certainly be considered uneconomic animals in advanced dairy countries, but under our conditions of production they could, if well looked after, bring in a good profit.

2. Food cost is the greatest single item in the cost of producing milk and the profit or loss that accrues from milk production is, to a very large extent, determined by the cost and efficiency of the ration. Each cow has a definite hereditary maximum producing capacity. The extent to which her production reaches this capacity is determined by the quantity and quality of the food given. It is profitable to feed each cow so that she can approach the highest production of which she is capable, but the use of additional feed would be wasteful, as it would result in accumulating unnecessary body fat that would *further* increase the food required for maintenance. Thus milk yield response to extra food reacts in much the same way as crop yields when dressed with extra fertilizers. The first additional pound of concentrates produces more extra milk than the second or subsequent ones, and eventually the rations may be increased to a stage where the response to extra food is negligible. The table above shows that the return per extra food unit fed declines as milk production increases. When milk production increases from 4,400 to 6,600 lb. the gain per extra feed unit is 0.55 lb. but with the same increase from 11,000 to 13,000 lb. it is only 0.22 lb. Furthermore, it must be stressed that for very high production of milk and increasing part of the feed must be of top quality (concentrated food rich in protein), and this would mean that the actual gain by extra feed would be less than indicated above as the average cost per unit fed would also increase. The above circumstances are only applicable in such cases where the ration is well computed furnishing the cow with all her nutritional requirements. If a ration is badly computed, e.g., if it lacks in one or more of the important components, which is often the case particularly in regard to proteins, then the result is a poor milk return and high cost of production. Such bad feeding technique is very common in this country, chiefly because cheap feeding is the main consideration, and this neglect of the cows requirements leads invariably to poor economy in dairying. Turning again to the question of intensity of feeding, it should always be borne in mind that the production optimum and the economic optimum are not always reached at the same level of feeding. The optimum production of milk will as a rule be reached only after a certain amount of over-feeding has taken place. This is for the reason that though the return of milk obtained from each additional unit of the *production ration* fed reaches a point where it starts declining, as shown in the table above, the return per additional unit of *total ration* fed, viz., the maintenance and production ration togther, will continue to increase to a certain point beyond this limit, as the maintenance ration remains the same. The production optimum is the point where the maximum return of milk is obtained from one unit of the *total ration* fed, while the economic optimum of production can be either higher or lower depending on current prices of food and milk, &c. The economic optimum will be at the point where for the last rupee spent one gets exactly one rupee's worth of product back. Thus if the price of milk is very high compared with the cost of food and other expenses involved, then it pays to adopt heavy feeding, while if the opposite is the case, the intensity of feeding should be adjusted accordingly ; but under-feeding should, however, never be done as it will

always pay better to utilize the production capacity of the cows fully rather than to reduce the number of cows during such times when very low prices of milk prevail. The adequate but economical feeding of each dairy cow in the herd is probably the dairy farmer's greatest managerial problem. Its satisfactory solution is lacking in most unprofitable dairy enterprises.

Feed costs for both purchased and farm-grown food is from 60-80 per cent. of the total expenses per cow. A study and analysis of feeding practices and costs is the dairy farmer's most important means for increasing his profit by either (1) reducing costs without reducing income, or (2) considerably increasing his income without greatly increasing his costs.

In livestock feeding maximum use should be made of the lowest-cost nutrients and minimum use of highest-cost nutrients. The lowest-cost nutrients are roughages grown on the farm fed fresh or as hay and silage. Of all farm-grown food pasture is the most economical source of nutrients for dairy herds, as the cows walk to the fields and do their own foraging thus saving labour and equipment costs. The contribution of roughages to rations for dairy cows in Ceylon is, however, far too small. Most roughages fed are of unsatisfactory quality, consisting mainly of coarse fodder grasses most of which are harvested at too mature an age and therefore providing fodder which has only little nutritive value for milk production. There is in this country immense scope for that of grass land and fodder production (improvement and expansion). Appropriate measures in this field would not only bring about considerably increased, but also a much cheaper production of milk. Furthermore, such crops would fit well into a rotation with other crops including paddy. The failure on the part of the dairy farmers to grow sufficient and good quality roughage (including pasture) for feeding their stock is one of the main causes for the very poor results obtained in most dairy farms and holdings.

The circumstances indicated above should, however, not lead to the conclusion that in case such development takes place purchased concentrates could be done away with entirely. It is true that very good yields can be obtained by feeding roughage and pasture alone, but this calls for a very high quality of roughage and considerable skill in management. As a rule the most economical production of milk is obtained when purchased concentrated foods are used for supplementing the home-grown food. The main purpose of feeding concentrates is to provide each cow with nutrients adequate in quantity and quality to maintain production at the maximum level of which the cow is capable. Concentrated food supply ingredients that may be lacking in the other foodstuffs and the proportion of concentrated foods in the ration should always be such that it also ensures efficient utilization of the roughage fed. Whether it is economical or not to feed more concentrated food than is actually required for balancing the ration depends entirely on the prices of (1) milk, and (2) concentrates. Under favourable conditions it might often be economical to make intensive use of concentrated feeds. Ceylon is fortunate in that good concentrated food is available at a very reasonable price. I have in mind in particular, coconut cake, which is produced in large quantities locally. Coconut cake or poonac is an excellent cattle food which may safely constitute about 70-80 per cent. of the concentrate mixture as both in regard to proteins and starch, it is well balanced for milk production.

When a large percentage of coconut cake is used the remainder of the ration, 20-30 per cent. could be made up of other locally-produced ingredients such as fish meal, rice bran, grains and pulses all of which are likely to be produced in the future in increasing amounts. Ceylon need not therefore look to other countries for cattle food if good use is made of locally-produced concentrates and adequate amount of pasturage and roughages are fed. In spite of this fact, it is very common to hear complaints about the high prices of cattle food and that because of this the production of milk is not an economical proposition. The figures given below should, however, help to convince dairymen that prices here are very low, and if milk cannot be produced profitably in spite of a such favourable relationship between the prices of concentrates and of milk then the reason for this is most likely because not enough attention has been devoted to the production of farm-grown fodder. I am not here referring to the congested town dairies, but to others which are well placed for land.

Approximate average prices for concentrates (mixtures) for dairy cattle in various countries in relation to the price of milk are as follows:—

	Per lb. *Rs. c.*	
U. K.	.. 0 24	One gallon of milk pays for 6 lb. concentrates
Sweden	.. 0 22	,, ,, ,, ,, ,, ,, 6 ,, ,,
U. S. A.	.. 0 21	,, ,, ,, ,, ,, ,, $7\frac{2}{3}$,, ,,
Denmark	.. 0 22	,, ,, ,, ,, ,, ,, $5\frac{2}{3}$,, ,,
South Africa	.. 0 15	,, ,, ,, ,, ,, ,, $7\frac{1}{2}$,, ,,
Ceylon	.. 0 12	,, ,, ,, ,, ,, ,, 25 ,, ,,

3. There is no statistical data available in Ceylon to show the labour required for dairy farming, but there is no doubt that considerably more labour is used here than in more advanced dairy countries. Labour saving equipment has not yet been brought into use, except in a very few cases, neither is it likely to be so for some years to come as the present wages paid in Ceylon do not encourage such development. In this connection it might be mentioned that machine-milking would be more expensive than hand-milking under present conditions and that mechanical milking does not offer other advantages which justify its introduction as yet. Labour is not at present a limiting factor in the Island's dairy economy in contrast to many other countries where this presents many difficulties.

Labour is readily available here and the wages comparatively low:

In U. K. one gallon milk pays for	$\frac{2}{3}$	hours	wages approx.
,, Sweden ,, ,,	$\frac{2}{3}$	,,	,,
,, U. S. A. ,, ,,	$\frac{1}{2}$	,,	,,
,, Denmark ,, ,,	$\frac{2}{3}$	,,	,,
,, S. Africa ,, ,,	$2\frac{1}{3}$	,,	,,
,, Ceylon ,, ,,	10	,,	,,

If we consider a labourer's wages for the year in terms of lb. milk sold at prices prevailing in the particular country then it would work out thus:

In the U. K.	35,000 lb.	of milk are required to pay one year's wages for a labourer
,, ,, Denmark	38,000 ,,	,, ,, ,, ,, ,, ,, ,,
,, ,, U. S. A.	58,000 ,,	,, ,, ,, ,, ,, ,, ,,
,, ,, Sweden	38,000 ,,	,, ,, ,, ,, ,, ,, ,,
,, ,, Ceylon	3,200 ,,	,, ,, ,, ,, ,, ,, ,,

The average production per cow for instance in Denmark is approximately 8,000 lb. and thus the entire production of 4.6 cows is required for the payment of the wages of a labourer for a year. In Ceylon taking for granted that the average production per cow is 1,100 lb. 3 cows would similarly pay one year's wages for a labourer.

4. The maintenance of a herd of milking cows, at a satisfactory level of production requires the replacement of about one out of five or 20 per cent. of the average number of cows each year. Losses by death (of cows) would as a rule average about 2 per cent. and culling for production and disease will remove the other 18 per cent. These figures will of course vary widely from year to year and from herd to herd, but the above figures are a rough guide to replacement needs. If replacements are purchased as cows, as it happens in some of the town dairies, then the replacement would be much higher probably 30 to 50 per cent.

The yearly cost of replacements is determined by the difference between the cost of rearing or buying the new cow and the price which is obtained for the one sold out, and also by the average number of its productive years in the herd.

$$\text{Replacement cost per year} = \frac{\text{Cost of rearing (or purchase)—sale price of old cows}}{\text{Number of years in production.}}$$

But to the above must also be added wastage by death of young stock intended for replacement.

It is common in Ceylon for dairy farmers to provide their own replacements by rearing a sufficient number of heifers, but in some cases people prefer to buy their replacements at a comparatively high cost rather than take the trouble of bringing up calves born on the farm. The latter system is, in this country, causing severe losses of potentialities of milking stock as the mortality among calves in such dairies is extremely high.

It is true that the cost of rearing heifers up to milking age is high and that this expenditure is a heavy item in dairying. But it is one on which too much saving should not be effected as inadequate feeding during the growing period often creates weakness which later tend to reduce the milking capacity and frequently paves the way for a breakdown if the animal is subjected to any serious strain. In stead efforts should be made to bring up heifers so that they come into production at an early age. It makes a great deal difference to the economy whether heifers start producing when $2\frac{1}{2}$ years or $3\frac{1}{2}$-$4\frac{1}{2}$ years old, as is most commonly the case in Ceylon, although there is evidence to show that heifers can reach maturity here if well looked after, as early as in most western countries. It should also be kept in mind that poorly-fed heifers seldom make cows with strong constitution, but far

too often they have to be disposed of after a few years of production. The latter has a very great influence on the economics of dairying as it costs approximately twice as much to produce one gallon of milk from a cow leaving the herd after 2 lactations as from a cow which has given five lactations.

The cost of rearing heifers is considerably lower in Ceylon than in most other countries. In Ceylon, with present prices on cattle food, milk, &c., a heifer can be reared up to maturity for about Rs. 420 (average cost in Government cattle farms) while in the U. K. it costs about Rs. 600 and in the U. S. A. about Rs. 700. The average cost in Ceylon is, however, probably somewhat higher than indicated above, partly due to the high mortality among growing stock and partly because of late maturity due to inadequate feeding. The very low prices obtainable for the cows disposed of make the cost of replacements heavy while in most other countries such disposals tends to balance the cost of replacements.

In connection with replacement costs there is one managerial aspect which needs mention because it is very often neglected here or its importance overlooked. It is very common in Ceylon to find that in a milking herd only 30-50 per cent. of the cows are in milk, while the others are divided into what are called " dry " cows and pregnant cows. Such a state of affairs does not only indicate very poor management, but also results in poor economy. This is brought about by not serving the cows in time and thus prolonging the " dry period " during which they have to be fed although they are not productive. In a well-managed dairy farm there should be only a milking herd and a heavy pregnant herd and on an average 70-80 per cent. of the cows should be in milk. Service of cows at correct time ensures high birth rate and more animals for replacement and sale.

5. Overhead costs of depreciation and interest, &c., are no large items and they seldom have much effect on total costs and financial security. To have good stock and adequate facilities is an advantage, but a dairyman's financial strength can be weakened by heavy liabilities on non-essential facilities. Too much building area, &c., increases labour on maintenance. A small milking barn can accommodate many cows in successive groups, and a lower investment is required for the storage and handling of hay, silage and purchased cattle food when maximum use is made of pastures. Ceylon is fortunate in having such climatic conditions that only very simple and cheap housing is required ; and as regard equipment, &c., the capital investment can also be kept at a low level so long as labour is available at a reasonable price.

Miscellaneous costs comprise items like bull upkeep or stud fees, veterinary fees, medicine, consumable dairy stores (exclusive of cattle food) and other expenses directly chargeable to the dairy herd or necessarily incurred in milk production. Miscellaneous and overhead costs should, under Ceylon conditions, never amount to more than about 10 per cent. of the total cost of milk production and the effect of this group of expenditure items on the final economic result will, therefore, always be very limited.

An aspect of dairy farm organization still to be discussed is that of the size of herd in relation to availability of land. Generally speaking a well-organized dairy farm business is one where herd size is fitted to the amount of feed that can be produced most economically on the farm ; and where labour supply, buildings and equipment are fitted to size of herd.

Roughage production on the farm from both crops and pasture is a very important consideration, since farm grown forage is usually much cheaper than feed purchased and transported. Above all, however, the organization of dairy farming should be adjusted to conditions prevailing in the locality such as: market possibilities, value of land, availability of labour, system of agricultural cropping, producing capacity of available stock, and most important, a proper integration of other activities on the farm or holding if any, viz., paddy cultivation, coconut plantation, &c. The degree of intensity of dairy husbandry should be determined by the above conditions in order that the best possible economic result might be obtained.

In conclusion I should like to stress the importance of good management, as even the best of dairy farms will not be financially successful unless it is well managed. To employ good management practices all the while is the dairyman's safeguard in bad times and an assurance of higher profits in good times.

Summary

1. There is a general tendency in Ceylon to consider dairy farming as of minor importance in the agricultural economy and as an unattractive commercial undertaking. It is shown that this is not justified as dairy farming, even with the rather poor stock available, could be made a profitable business under present conditions of production.

2. The present relationship between food prices, labour cost and milk price is very favourable, but the failure on the part of Ceylon's dairymen to produce sufficient quantities of home-grown fodder accounts for poor economy in many dairy enterprises. There is in Ceylon immense scope for grassland and fodder production, improvement and expansion.

3. The art of management is the most important factor in the success of any dairy farm business.

Agriculture in the Northern Division

S. K. THURAISINGHAM

Geography

THE Northern Division comprises the whole of the Northern Province including the Islands. The Jaffna Peninsula and a group of Islands lying off the west coast form one part, and the mainland consisting of the Karachchi and Pooneryn Tunukkai Divisions of the Jaffna District and the two Districts of Vavuniya and Mannar form the other part. The area of the Province is 3,429 square miles of which 75 square miles are covered by water leaving a land area of 3,354 square miles. Of its total acreage 10.6 per cent. is cultivable. The cultivable paddy lands form 40 per cent., the coconuts 11.5 per cent. and home gardens rotation crops, &c., form 48.5 per cent. of the cultivable area. The Jaffna Peninsula and the Islands are flat. There are no rivers. In many places the sea runs in and forms large lagoons which cut right through the centre and eastern portions of the Peninsula. The southern portion of the Peninsula is sandy and covered by shrub jungle with coconut plantations on the west coast and palmyrah along the east coast. The northern portion, except for scattered patches of rocky land, is almost entirely garden cultivation ; paddy, tobacco, chilli, cereals, &c., are grown. On the other hand, the mainland is covered with jungle which is only broken here and there by cultivation and habitation close to a tank. The Mannar Island is open sandy shrub land. Along the western coast which skirts part of the mainland of the Mannar District, and along the north-eastern coast of the Province, salt marshes alternate with jungle. The major portion of the Vavuniya District is a tableland rising to about 300 feet above sea level, and there are a few rivers which flow only in the North-East Monsoon season.

Rainfall

The rainfall for the Province in 1952 was as follows:—

	Jaffna District		*Vavuniya District*		*Mannar District*	
	Rainfall Inches	*No. of Rainy Days*	*Rainfall Inches*	*No. of Rainy Days*	*Rainfall Inches*	*No. of Rainy Days*
January	4·40	8	6·66	7	4·26	9
February	1·36	3	1·92	1	1·89	3
March	1·85	3	2·42	4	2·14	4
April	2·41	5	4·51	9	3·83	7
May	1·95	3	3·23	5	1·98	4
June	0·40	1	1·07	1	0·33	1
July	0·52	1	1·09	1	0·30	1
August	1·19	3	2·64	3	0·64	2
September	2·36	4	3·67	2	1·13	3
October	9·31	12	8·74	18	7·25	11
November	17·01	18	14·85	12	10·64	17
December	10·88	14	12·47	24	7·67	14
Total	53·64	75	63·07	87	42·06	76

The Northern Province experiences one main Monsoon season, the North-East Monsoon, and little or no rain fall during the South-West Monsoon. Even during the North-East Monsoon season the rainfall is restricted to the three months October to December during which period heavy precipitations of as much as 5 inches and over in a day are not infrequent. Failures of the North-East Monsoon have not been rare, especially in recent years, and these have resulted in total loss of crops grown.

The main cultivation is determined by the rainfall and therefore coincides with the North-East Monsoon season. All rainfed crops are planted at the commencement of the North-East Monsoon season. The annual crops grown are such that they mature at the end of the Monsoon season. Little or no rainfed crops are sown for the South-West Monsoon season. Although the North-East Monsoon cultivation is the major season, yet where ample irrigation water can be had from wells the actual planting or sowing is done with most crops at the tail-end of the Monsoon. It is not often that successful crops are raised with the Monsoon rains which, either due to scarcity or excess, cause some damage to crops in most years. The Jaffna Peninsula and parts of Vavuniya District receive a fair rainfall during the North-East Monsoon ; yet where there are wells with abundant supply of water the cultivators prefer to commence cultivation of crops such as chilli, onions, tobacco and local vegetables towards the tail-end of the season to avoid damage by excess or scarcity of rain.

A major portion, in fact about 80 per cent. of the cultivated area under irrigated paddy in the Northern Province, depends on the water in the minor and major tanks for cultivation. These tanks fill in a normal North-East Monsoon season, and cultivation is undertaken either in anticipation of the tanks filling or after the tanks are full.

The rainfall in normal years should be sufficient to fill a number of tanks which can be restored or are in the process of being restored.

Land, Land Tenure and Capital

The area of land actually taken up for cultivation at one time or other does not total more than 10.25 per cent. of the total area of the Province. On a rough estimate another 40 per cent. of the land can be taken up for cultivation of paddy under irrigation, for dry farming and for cattle raising. The Iranamadu Augmentation Scheme and the restoration of tanks such as Vavunikulam, Akkarayankulam in the Jaffna District, Pavatkulam, Muthainkaddu and Thanimuruppu in the Vavuniya District and the Malwatuoya Scheme in the Mannar District, in addition to restoration of numerous minor tanks now lying in disuse should considerably increase the extent cultivated. Extension of cultivation even under the tanks restored, or whose supplies of water have been increased, tends to be slow due to want of capital.

Government assistance to develop land given out on permits, and the establishment of colonization and village expansion schemes under major and minor tanks, have assisted to a great extent in extending the area under cultivation.

One of the chief drawbacks to increased production and investment of capital on land is the insecurity of tenure. The issue of Crown land on permits, and the non-granting of outright sale permits, have to a great extent withheld capital which otherwise would have been invested on land. Another major reason for non-investment of capital on the land is the high cost of developing. Cheaper and quicker methods should tend to attract capital. The use of high-powered machinery in asweddumizing land for paddy and for reclaiming rocky land in the Jaffna Peninsula should attract capital because of the economic minimum prices guaranteed by Government for products such as paddy, cotton, chilli, onions, &c.

There are very few colonization or village expansion schemes. There is only one colonization scheme in the Jaffna District. With the restoration of minor and major irrigation schemes more colonization and village expansion schemes are under consideration or are in process of being established.

In recent years the organization of Co-operative Production and Sales Societies have assisted the cultivators in obtaining the capital they require for agricultural purposes. Short-term loans are granted by these societies for the purchase of seed for cultivation, for harvesting and marketing, and long-term loans for purchasing equipment such as barbed wire, pumps for irrigation, &c., and for the development of land.

The fixed rent systems of tenure now existing in most parts of the Province are fair and reasonable. However, the insecurity which now exists tends to deter general adoption of improved methods or the improvement of land.

In the Sinhalese D. R. O's Division of Vavuniya South the ancient system of " ande " is still in force.

Area of Holdings

The number of holdings and cultivable extents recorded according to the 1946 Census are as follows:—

	Holdings	*Cultivable Acres*
Jaffna District	210,395 ..	151,384
Vavuniya District	16,050 ..	31,650
Mannar District	14,738 ..	37,535

The cultivable land is largely paddy and the analysis of holdings according to the 1946 Census is as follows:—

	Jaffna District No. of Holdings	*Vavuniya District No. of Holdings*	*Mannar District No. of Holdings*
Total number of holdings ..	57,484 ..	8,258 ..	9,044
Holdings less than $\frac{1}{2}$ acre ..	26,282 ..	240 ..	1,074
Holdings between $\frac{1}{2}$ and 1 acre ..	17,144 ..	1,165 ..	1,331
Holdings between 1 and 2 acres ..	8,699 ..	2,108 ..	2,283
Holdings between 5 and 10 acres ..	727 ..	989 ..	939
Holdings between 10 acres and over ..	478 ..	247 ..	303

Even though the average size of holding owned by each is small in the Vavuniya District and the Mannar District, yet the actual extent cultivated by a cultivator is larger due to the smaller number of persons interested in agriculture. The extra land is obtained on lease. The distribution of the size of holdings given above for Jaffna District is even true of the size of holdings cultivated by a cultivator.

The extents of land cultivated with crops other than paddy are also small in the Jaffna District where intensive forms of cultivation with irrigation from wells is done. The income however is high because of the high yields obtained. These crops are cultivated in the Vavuniya and Mannar Districts on an extensive scale depending on the rains due to the absence of wells for irrigation. As yields under such conditions are poor, larger extents are cultivated to obtain the required income.

Soils

The soils of the cultivated area and of much of the uncultivated land in the Northern Province can be said to be fertile, except for a few tracts scattered throughout the Province which had been selected for cultivation owing to the proximity to their homes by a population which took to agriculture as a part-time occupation such as in Mannar Islands and along the east and west coasts of the Province where fishing is the main occupation.

With a few exceptions the whole of the Northern Province has the red to yellowish-red soils of the dry zone varying in texture from light sandy to heavy loams and contain high proportions of gravel and limestone. These soils respond well to cultivation of annual crops for the first two or three years, but subsequent yields are low. The exceptions, however, are:

(i) The red soils of the Jaffna Peninsula formed from sedimentary limestone, largely calcium carbonate, which vary from light to heavy loams overlying limestone rocks. These soils store a fair proportion of the rainfall that falls on the land.

(ii) The brownish-red soils close to Mullaitivu probably of pleistocene deposits overlying gneiss rock borne from the hills, poor in organic and mineral content.

(iii) Heavy dark clay loams of the Giants Tank area, which are poor in mineral and organic material, but which respond well to deep cultivation and are only suitable for wet cultivation of paddy.

(iv) The characteristic black soil found at Tunukkai which cover an extent of about 16 square miles. The soil resembles the black cotton soils and does not drain well. It is a heavy loam poor in organic and mineral matter.

(v) The calcareous loams found in the Islands. This greyish white calcareous loam comprised of miocene limestone is poor in organic matter and nitrogen.

Special reference has to be made to the reclamation of land in the Jaffna Peninsula and the Islands. A fair portion of the land now under cultivation in the Jaffna Peninsula was rocky land reclaimed in the last century or so. The process involved is long and tedious. The rock which is not in one mass but mixed with soil is removed in small stages by digging by hand and at times by blasting. After the rocks are removed all the rocky materials

and gravel are sifted out and the soil levelled. The cost of reclaiming an acre of land is in the neighbourhood of Rs. 6,000. There is very little land now not cultivated which is free from rocks. The extent that could be reclaimed and utilized for the cultivation of the two commodities, chillies and onions, which are in short supply is about 700 acres. The use of a D/8 Tractor with a ripper may expedite reclamation. This possibility is under investigation.

Population and Labour

The population for the Province is 571,214 persons according to 1953 Census, over 75 per cent. of whom are resident in the Jaffna Peninsula. The following are the figures for the various Districts:—

District	*Area*	*Population*	*Density per Sq. Mile*
Jaffna Peninsula	410¼ sq. miles	.. 414,326	.. 1,009
Jaffna District not including the Islands but excluding the Peninsula ..	554½ ,,	.. 78,058	.. 140
Vavuniya District	1,431½ ,,	.. 35,119	.. 24
Mannar District	957¾ ,,	.. 43,711	.. 45

This uneven distribution is the main cause not only for the cultivated extent being small but also of the extensive methods of cultivation followed in the Vavuniya and Mannar Districts. Where the population is dense small extents of land are cultivated intensively. In the thinly-populated areas where the wants of population are few and the holdings are large there is generally a marked absence of enthusiasm to increase yields.

Scarcity of labour in the thinly-populated areas where there is ample land and abundance of irrigation facilities has, roughly speaking, acted as a deterrent to any form of large-scale investments of capital in agriculture. The present methods adopted in cultivation are unattractive to the youth. There is general dislike to any form of manual labour or to the handling of cattle, especially buffaloes. Mechanical forms of cultivation may prove to be more attractive.

Transport and Marketing

The slow and uncertain transport in the past has been replaced by more efficient motor transport. Except in the remote parts of Mannar and Vavuniya Districts the existing roads have been improved and new roads have been constructed in the Province to enable the producer to market his produce cheaper and more efficiently, so much so that produce is saleable today from the threshing floor. Losses incurred in transport of perishable produce have been reduced to a minimum with the use of motor transport, and the refrigerator van transport under consideration by the Co-operative Department should further reduce loss. The Province in addition to being served well with road transport is also served

efficiently by railway transport. The Jaffna-Colombo and Talaimannar-Colombo main lines pass through the Province, and at every five to ten miles sidings and stations cater for transport of agricultural produce.

Marketing has improved considerably. There are Marketing Department organizations in the three main centres, Jaffna, Vavuniya and Mannar, to assist the villager to market his produce profitably. The Co-operative Production and Sales Societies which number twenty-one in addition assist in marketing the produce of members. Paddy is collected by these Societies and sold to the Director of Food Supplies, or is supplied to rice mills worked by Co-operative Societies or by the Commissioner for Development of Marketing. The Co-operative Production and Sales Societies have been appointed agents by the Commissioner for Development of Marketing for the purchase and supply of produce from the villagers at fixed prices. These Co-operative Societies also assist the villager to market his produce through the Co-operative Central Market in Colombo or through an organization such as the Co-operative Wholesale Establishment.

In addition to these facilities fairs are held three days in a week at Chunnakam, Chavakachcheri, Kodikamam, and once a week at Palai Paranthan and Killinochchi in the Jaffna District, and once a week at Vavuniya. At these fairs the villagers are able to dispose of their produce at competitive prices.

Chewing tobacco meant for the Malayalam market is mainly handled by the Malayalam Tobacco Sales Society. Similar societies for marketing plantains and livestock and livestock produce are in existence and some are in the course of being formed.

Irrigation

The Northern Division, except Jaffna Peninsula and the Islands, is fairly well served by major and minor tanks. The Karachchi Irrigation Scheme in the Jaffna District, Kanagarayankulam, Kanunkerni, Vavuniya, Mamaduwa, Ulukkulama, Eratperiyakulam and Madukande Tanks in the Vavuniya District, and Giants Tank with its chain of minor tanks and the Agathimurippu Scheme irrigate 35,000 acres. The minor tanks scattered through the mainland of Jaffna District, Vavuniya and Mannar Districts irrigate 18,300 acres.

In the Jaffna Peninsula a number of salt water exclusion schemes are under construction to prevent innundations of land with salt water. The Valukki Aru Scheme in the Peninsula assists holding up water in a drainage channel to maintain the moisture of the soil on either side of the Aru. The irrigation of highlands is done from wells and described in full under irrigation of annual crops.

Paddy Cultivation

Almost 40 per cent. of the cultivable area is under paddy. Of a total of 98,881 acres of paddy about 46,000 acres are rainfed and the rest irrigated from a major or minor tank. The rainfed paddy areas are in the Jaffna Peninsula, around Mullaitivu in the Vavuniya District and along the coast in the Mannar District.

Dry Sowing

The cultivation of rainfed paddy differs from that of the irrigated paddy in that the paddy is sown dry and commonly called " Pluthi " as the seed is sown on soil practically dust which is bereft of all moisture. Sowing is done before the rains expecting the seed to germinate with the first N. E. Monsoon showers. The main point underlying this practice is utilization of every drop of rain for the growth and maturity of the crop. Ungerminated seed is also sown on land prepared with the N. E. Monsoon rains. This is done to a great extent under irrigation schemes in the Mannar District as well as under the Karachchi Irrigation Scheme as a means of saving irrigation water, but it is attended by the risk of heavy weed growth if sufficient irrigation water is not available to flood the fields to smother the weeds that may come up with the paddy.

Wet Sowing

Where irrigation facilities are available and where soil conditions do not permit dry sowing, wet sowing is adopted. Wet sowing is invariably done under all minor tanks in the Vavuniya District and on the clay loams under the Giants Tank in the Mannar District. Wet sowing is favoured, for it ensures a thorough preparation of the land and reduction of weeds, as in the course of preparation, i.e., ploughing, bunding in water in the fields after ploughing, and puddling and levelling before sowing the germinated seed, weeds are destroyed and a quick start to the germinated seed is ensured.

Improved Methods

The implements used in paddy cultivation have been improved in recent years. About 26,000 acres are yearly ploughed, harrowed, and the broadcast seed covered by tractor-drawn implements. The use of the Burmese harrow for churning the soil and harrowing the standing crop is steadily on the increase. The use of iron ploughs, both light and heavy, are limited to areas where the soil is sandy, and where there is an availability of draught bulls suitable for use with these ploughs. In general the cultivator is reluctant to change his methods: but in recent years a desire on the part of the cultivator to increase the yield per acre has urged him to try different methods to improve yields as a result of the increased yields obtained in the demonstration plots laid by the Department of Agriculture. Some of the methods which are becoming popular are:

(*a*) Transplanting and manuring paddy by small holders to obtain the maximum yield.

(*b*) Weeding in areas where cheap labour is available.

(*c*) Harrowing the standing crop in areas where irrigation water is ample.

(*d*) Use of pureline seed of varieties generally recognized as suitable for the Province

Planting Seasons

There are three seasons for the cultivation of paddy—the Maha or Kalapogam, Meda or Idaipokam, and Yala or Sirupokam. The Maha cultivation is generally the main major season as it coincides with the major rainfall season, the North-East Monsoon. Generally the extent sown for Maha is very large and sowing dates vary considerably according to the availability of draught animals and labour.

A Meda season in the past was a rare occurrence ; but in recent years due to scarcity of labour and of draught animals, and to the late arrival of the North-East Monsoon rains, Meda cultivation is finding favour as a means of spreading out the cultivation to make the best use of the late rains and full use of the poor supply of draught animals and of labour. The sowing for Meda normally commences in early February and may extend even up to the end of March. Wet sowing is the most common form of sowing seed. The extent sown for Meda is approximately 5,000 acres, and is confined to the Vavuniya District.

The Yala season commences immediately before the Hindu and Sinhalese New Year. It is a means of utilizing irrigation water left over after cultivation for Maha in major and minor tanks. The extent cultivated for Yala in the Vavuniya District is invariably low due to the cultivation of paddy for Meda ; whereas under the Karachchi Irrigation Scheme in the Jaffna District, Kanukerni Tank in the Vavuniya District, and Giants Tank in the Mannar District where there is no Meda cultivation, the extents cultivated for Yala in normal years are fairly large and it may be as much as 50 per cent. of the total area under the tank. For Yala 1952 the proportions cultivated are 6,600 acres under the Karachchi Irrigation Scheme, 320 acres under Kanukerni and 2,420 acres under the Giants Tank. Tank beds under low sluices are usually cultivated for Yala under the Giants Tank.

Subsidiary Crops

In the Jaffna Peninsula where there are no tanks and where paddy is cultivated with the rains, certain tracts such as Pandatherappu, Changanai, Mathanai, Mathagal, Manipay, Vadaliaddaipu, Karainagar are cultivated with crops such as tobacco, chilli, onions, manioc, brinjals and vegetables with well irrigation. When well irrigation is not possible as in Vaddukoddai, Araly, Karainagar, Kalapoomi, Moolai, Tholpuram, Navaly, Kaddudai, Sandilipay, sunhemp is sown immediately after the harvest of paddy, with the moisture still in the soil, as a means of fertilizing the soil. This crop in addition yields fodder for cattle and a small income if the stalks are sold. On fairly high land a mixture of 3 measures of gingelly and 5 measures of green gram is sown. If there should be a few showers in March and April, the sunhemp, gingelly and green gram yields well. Nett incomes of Rs. 100 and over are not rare.

Subsidiary crops grown on an intensive scale on paddy land with well irrigation are as remunerative as those crops cultivated on highland. In addition, the paddy which follows these crops gives very high yields, in some cases as much as 48 to 50 bushels per acre. Paddy seedlings are raised with well irrigation for transplanting. This is necessary as the subsidiary crops occupy the land till the middle of October.

The cultivation of subsidiary crops on paddy land is not practised in any other part of the Northern Province.

Highland Cultivation

Under this heading the cultivation of crops other than paddy is dealt with, both perennial and annual.

Perennial Crops

Coconuts, arecanuts and fruit trees inclusive of mango, citrus, jak, pomegranate, &c., are cultivated. The palmyrah which is found in abundance in the north and east of the province, is not cultivated systematically and is mainly the outcome of fallen fruits allowed to grow unattended.

Coconuts cultivated along the east coast in Pooneryn in the mainland, along the coast of the Jaffna Peninsula and in gardens totals 24,232 acres. The land in which coconuts are cultivated is a very sandy loam ; and the success of this crop depends on the steps taken to conserve moisture and on the amount of organic manures added. Cattle, goats and sheep penning in addition to growing of *Tephrosia purpurea* as green manure are the main ways of adding organic material.

Fruit trees except in very exceptional cases are not cultivated on an orchard scale. In the case of the mango a few trees of each variety are planted in gardens. Very few gardens in the Jaffna Peninsula are without a few mango trees. In the Vavuniya and Mannar Districts it is the reverse, only a few gardens have mango trees. In the Jaffna Peninsula 90 per cent. of the trees are budded or grafted. The varieties on a rough estimate number over two hundred. The most common varieties are Vellai Columban, Karutha Columban, Ambalavi and Chembattan. Little or no systematic cultivation is done except in the early stages when the plant is nursed to maturity by manuring and irrigation. In normal seasons the price of a mango fruit varies between 10 and 20 cents.

Citrus on the other hand is more popular in the Vavuniya District than in the Jaffna or Mannar Districts. Vavuniya sweet orange takes pride of place amongst the varieties cultivated in Ceylon. They are large, loose skinned and medium sweet. A few trees in each compound are more general than large orchards. There are only six orchards of an acre or more. The short life of orange trees, especially of budded trees, has to a great extent discouraged large orchards. Seedling plants tend to live longer than budded plants. Unlike the mango, citrus plants are systematically manured and irrigated. Heavy dressings of organic material and regular irrigation tend to extend the life of a plant. One or two orange plants per compound, and that too far and apart, are found in the Jaffna Peninsula. The other citrus variety which is commonly cultivated throughout the Province is the lime plant which is found cultivated under irrigation in all gardens. The most popular variety is one akin to the British Guiana lime. Lime trees are forced to bear right throughout the year by heavy dressings of organic material and regular irrigation.

Miscellaneous fruit trees such as pomegranate, grape vine, sapodilla, breadfruit, &c., are cultivated in scattered gardens in the Jaffna Peninsula. Pomegranate yields fair harvests in Point Pedro and Kayts in the Jaffna District, and in the Mannar Islands in the Mannar District where the sandy soil and dry climate are suitable for this crop. Grape vine was at one time a very good source of income to the cultivators in Mathagal, Sillalai and Vasavilan

in the Jaffna Peninsula; but in recent years the cultivation of this crop is on the decline mainly due to the incidence of pests and diseases which the cultivators find difficult to control.

Annual Crops

There are two main forms of cultivation—one extensive under rainfed conditions, and the intensive method with irrigation from wells. The extensive form is mainly confined to gardens and chenas in the Vavuniya District and provides part occupation to those who are really paddy cultivators. The gardens are blocks of land adjoining dwellings. These are prepared for planting crops such as chilli, manioc, maize, cowpea, sorghum and vegetables with the first showers of the North-East Monsoon. In normal years of rainfall very remunerative incomes are obtained by the sale of green chilli and vegetables which come into production in December when there is a demand.

Chena cultivation in recent years is confined to blocks of Crown jungle given out to middle-class persons and peasants in the Vavuniya, and to a very few in the Mannar and Jaffna Districts. Paddy chenas are more popular than a mixture of kurakkan, cowpea, mustard, chilli, maize, &c. This change over is partly due to the change in the issue of land permits which are confined to land which can be asweddumized as paddy land. Middle-class allottees seem to prefer paddy. These allotments will, in time, have permanent crops such as citrus, and annual crops such as chilli and onions under well irrigation. All land both highland and chenas cultivated extensively are with few exceptions sown in March and April with gingelly and green gram immediately after the harvest of the Maha crops.

The general trend in recent years is towards the intensive form of cultivation. This is due to the fairly high minimum prices guaranteed, and because of the increase in marketing facilities provided for products such as chilli and onions and the high prices realized for local and Malayalam tobacco, plantain, betel, and local vegetables.

In the past intensive cultivation of crops such as chilli, tobacco, plantains and onions were confined mainly to the Jaffna Peninsula; but during the past ten years the intensive form of cultivation has increased considerably in the Vavuniya District.

The intensive form of cultivation depends on the availability of water for irrigation from wells. Sinking of wells with good supplies of water is a certainty in the Jaffna Peninsula. Water levels in the Jaffna Peninsula are more or less maintained right throughout the year because of the regular flow into the well of water held in the numerous cavities of the sub-soil rock formation.

Wells with good supplies up to the end of July have been sunk in a few centres in the Vavuniya District. A few such centres are Rambaikulam, Vairavapuliankulam, Sinnakulam, Puthukulam, Thatchankulam, and Kulamkulam in Vavuniya South Tamil Divisional Revenue Officer's Division; Odduchuddan, Nedunkerni, Thanduwan, Palampasi, Mamadu in the Vavuniya North Divisional Revenue Officer's Division; and Muliavalai Taniyuthu, Kumulamunai and Kanukerni in the Maritime Divisional Revenue Officer's

Division. With the restoration of tanks in the District more centres with good supplies are now found. Wells in the Vavuniya District depend on seepage water from the neighbouring tanks.

A well in the Jaffna Peninsula will irrigate about $2\frac{1}{2}$ acres whereas a well in the Vavuniya District can irrigate only one acre because of the poor flow.

Water is lifted from the well by means of well sweeps, single mhotes, double mhotes and pumps. The layout of the land for irrigation varies with the crop cultivated, and a full chapter could be written on the subject if it is to be dealt with in detail. The layout presents no difficulty as the land is level. Leading of the water into bays planted with the crop is the commonest method of distribution of water. The channels, bays, &c., are so designed that it is not only economical in labour but also saves water and time in irrigation.

A rough estimate of the acreage and crops cultivated are as follows:—

Crop	*Rainfed*	*Irrigated*
Chilli	480 ..	2,720
Tobacco	— ..	3,000
Onions	— ..	5,000
Manioc	900 ..	500
Maize	505 ..	—
Sorghum	350 ..	—
Gingelly	3,000 ..	—
Green gram and other pulses ..	550 ..	400
Local vegetables ..	350 ..	1,550
Yams	— ..	250

Definite forms of rotation are practised. The land is manured so heavily that as many as three crops are taken in one year from the same land. The most common rotation was tobacco and a cereal followed by a short-term legume such as green gram, all cultivated in the course of the same year. In recent years due to the fall in prices of cereals, onion which has a very remunerative minimum guaranteed price is cultivated instead. There are rotations with chilli as the major crop followed by a cereal. A five-year course rotation is practised in areas where plantains are cultivated. If yams which occupy the land for nine months is the main crop, yam is planted with mixed local vegetables such as brinjals, pea, &c. Manioc is often found in a rotation and mainly on land which requires cleaning. Manioc is planted on this as a single crop, or mixed with a cereal or onion.

Rotations vary according to place and convenience of cultivators; but in all cases the principles underlying rotation are not lost sight of.

The actual commencement of cultivation of annual crops is the tail-end of the N. E. Monsoon season, that is December. The three main planting seasons are the December, April and July planting seasons.

The heavy manuring consists primarily of dressings of earth manure and green leaf ; cattle and sheep manure is also very common. Growing of sunhemp as a green manure is very widely done. Hedges planted with Gliricidia, dadap, tulip, &c., provide a fair portion of the green leaf required.

Livestock

The livestock population as enumerated in the Census of 1946 is as follows:—

	Cattle	*Buffaloes*	*Goats*	*Pigs*	*Fowls*	*Sheep*
Jaffna District ..	94,128	1,098	70,784	119	111,215	7,000 (Estimated)
Vavuniya District ..	13,848	7,829	1,184	30	9,615	—
Mannar District ..	12,758	7,415	6,791	23	11,772	—

There is very little difference in the number of cattle and goats, but the number of poultry has increased considerably since the Census.

The type of livestock in the Province is in keeping with what may be called an equilibrium with the food supply, and any change cannot be seen in the type without seeing some change in the means of feeding and management. For example, in the Jaffna Peninsula where the standard of feeding and management are far superior to that in the rest of the Province, the livestock maintained are definitely of a better type.

Except for pure-bred draught cattle and a few cows imported from India, the rest of the cattle in the Peninsula are crossbreds. Both European and Indian breeds have been utilized in the evolution of these types. The cattle in the rest of the Province consist mainly of the Singhalese type bred indiscriminately.

The goats in the Jaffna Peninsula are crosses of the Jamnapari, Kamouri, Alandi and Surat breeds with the local indigenous breed. The goats in the Mannar and Vavuniya Districts are of the meat type and are akin to the South Indian goats. The original stock seems to have been imported from South India and fresh blood introduced from time to time.

The poultry in the Province are as a rule of very mixed breeds. The R. I. R., Australorp and White Leghorns breeds have been utilized from time to time to improve the stock. Poultry-keeping could, having careful regard to the limitations of feeding and breeding, be very considerably improved.

Sheep are generally utilized for manuring, and thrive on the sparse grazing available in the Jaffna Peninsula.

Buffaloes provide the main draught in the cultivation of paddy. These maintain themselves on the grazing available in the jungle and tank beds. Very little progress has been made with the breeding and feeding of buffaloes.

PHOTO 1.—Bullock operated water lift on well.

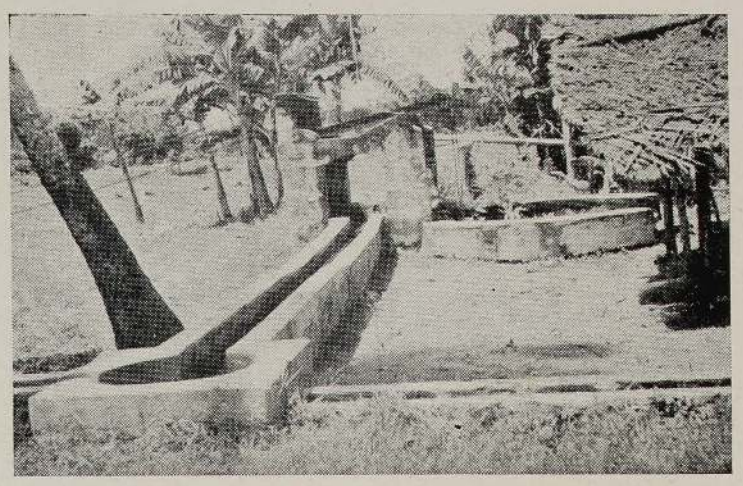

PHOTO 2.—Flume from well.

PHOTO 3.—Lined pond for irrigation.

PHOTO 4.—Irrigation from ponds with palmyrah pails.

PHOTO 5.—A garden of irrigated chilli.

PHOTO 6.—Penning cattle in Jaffna.

Observations on Drainage Conditions of Ceylon Paddy Soils with Particular Reference to those of the Low Country Wet Zone

J. G. VERMAAT

Introduction

SOIL productivity is the crop-producing potentiality of a soil. It is to be measured in terms of yield. The productivity as such is conditioned by physical factors, e.g., climate, depth of topsoil, nature of subsoil, drainage conditions, etc. The yield level is generally conditioned by these physical factors. These are fixed to a certain extent, and one can do relatively little about them, with the exception of drainage. They are controlled by nature (10).

Soil fertility is the capability of a soil to supply at any time nutrients to a crop in adequate amounts and suitable proportions. Fertility can easily be controlled by men (10).

Differences of several hundred per cent. are possible, even in adjacent fields as a result of differences in physical characteristics. A difference of 100 per cent. or so is seldom to be obtained by the application of fertilizers.

Hence comparative studies of yields are of great importance in tracing limiting factors in crop production. Dr. M. F. Chandraratne's preliminary yield survey, the first of its kind in Ceylon, showed already highly interesting and instructive figures. An illustration of this will be found in the data of Mr. R. S. Koshal's yield surveys during Maha 1951-52 and Yala 1952 covering the whole island. The following figures were obtained from the survey in Maha 1951-52.

Locality	*Province*	*Paddy in lb./acre*	*Clean Rice in lb./acre*
Ceylon ..	..	1,424 ± 19·5 ..	949·3 ± 13
Ratnapura District ..	Sabaragamuwa ..	1,018 ± 72·7 ..	678·6 ± 48·5
Galle District ..	Southern ..	770 ± 37·0 ..	513·3 ± 24 5
Kalutara District ..	Western ..	806 ± 61·8 ..	537·3 ± 41·2
Kandy District ..	Central ..	1,964 ± 116·1 ..	1,296·2 ± 77 4
Nuwara Eliya District ..	Central ..	2,192 ± 172 — ..	1,461·3 ∓ 114 6

The differences in yield of the various districts in the wet zone is such as to suggest the existence of limiting factors of a physical nature in the areas with a low yield. Therefore a preliminary survey of paddysoils was started in order to trace limiting factors in rice production in the S.W. It soon turned out that in all probability inadequate drainage was one of the limiting factors. In this paper conditions of drainage of paddy soils in the S.W. will be dealt with.

The Importance of Drainage for Paddy Soils

Rice is, to a certain extent, a water plant, but certainly not a marsh plant. Its roots are equipped with large cavities, which run from the rootcrown down to the very roottip, and are filled with O_2 and CO_2 and might be some other gases such as N. A gradient exists from the base of the roots to the tip. So it was found by van Raalte, who carried out these fundamental researches, that at the base of a 20 cm. (8″) long root the gasmixture in these cavities contained 9-14 per cent. O_2 and 2.8-6.1 per cent. CO_2 in different varieties. The corresponding figures for the roottip are 1.9-4.7 per cent. CO_2 and 2.1-8.1 per cent. O_2 (6). He further established the fact that the O_2 is taken up by the aerial parts and the rootcrown either in the gaseous or in dissolved form and is conducted to the lower parts of the roots through the aircavities in the cortex.

In a subsequent investigation van Raalte demonstrated that the roots also exude oxygen into the surrounding medium. In this way the paddy plant is in a position to create its own atmosphere around its roots and to thrive in a thoroughly reduced medium. Nutrient uptake in the rhizosphere can therefore proceed in the same way as in normal landplants (7).

As a result of the inundation the soilorganic matter, applied bulky organic manures, start to decompose under anaerobic conditions. It is due to a series of now classical experiments by Harrison and Subramaniam Ayer that we understand various aspects of the mechanisms involved. They found that in a cropped paddysoil CH_4 H_2, N, and CO_2 are formed. Bacteria reduce the CO_2 with the help of the H_2 to CH_4. So CH_4 and N gas accumulate and move upwards. The roots however form near the soilsurface, thus in contact with oxygen carrying water a network of fine roots. Between and over them a film of microorganisms (bacteria and algae) has formed. The bacteria oxydize the methane to CO_2 and H_2O and the algae during day time assimilate CO_2 and give O_2 off. So under the film and near contact with the roots O_2 accumulates in a gaseous form and dissolve in the water according to its pressure.

If drainage were quick much of the oxygen produced would go down in the soil and be utilized by the reduced substances there, and it might be doubted whether the roots could satisfy their requirements. By a moderate and slow drainage however the roots have ample opportunity to take all the oxygen they need and the balance either escapes through the supernatant water or drains off into the subsoil and is used for oxidation of reduced substances (3). Application of bulky organic matter on an adequately drained soil has the effect of increasing the oxygen supply to the roots (4, 5.)

Under flooded conditions the soil beyond the rhizosphere is fairly reduced and especially so when bulky organics such as green manure, cowdung or compost are amply applied. Not only toxic organic substances may be formed, but also nitrites and further ferrous iron and sulfides, all of which are highly toxic. Slow drainage partially takes care of their disposal. Ferrous iron and sulfide ions form the highly insoluble FeS. An excess of $Fe^{\cdot\cdot}$ which reaches the rhizosphere becomes oxidized and is precipitated in the ferric form. Hence a brownish red coating around many of the older roots may arise.

The amount of oxygen exuded by the root system of a two months' old paddy plant is 1-3 mg./day, sufficient to oxidize 7-21 mg. of $Fe^{\cdot\cdot}$ (7). In a soil which is freshly heavily green manured or to which large amounts of bulky organic matter have been applied the amount of oxygen exuded might not be sufficient to cause the ferrous iron to be precipitated

as ferric iron (7). Here we have the explanation for the observed fact that poorly drained soil should not be heavily green manured or receive large doses of compost or farmyard manure (Fe · · poisoning!).

These considerations are corroborated by investigations from Japan and Indonesia (9 : 2-3 ; 1 : 53-54 and 2 : 26-28), both countries in which much attention is paid to appropriate and adequate drainage.

For successful paddy growing water supply, water consumption and water losses have to be well balanced and in order to achieve this water control is required. But water control means the availability of adequate irrigation and drainage facilities, which allow control of irrigation and drainage and which is not or inadequately the case with the native irrigation and drainage systems (at least in the S. W.).

With irrigation facilities is meant a system of supply channels and or ditches equipped with gates (or sluices) and measuring weirs so that the amount of water supplied from a catchment or tank to tracts of paddy fields can be measured and controlled.

With drainage facilities is meant a system of ditches and channels equipped with gates (or sluices) and where necessary provided with pumps to dispose of any water in excess of the actual requirements of the tract under consideration. Especially during floods adequate drainage facilities prove their value.

The Water Regime of Paddy Soils in General and those of the South West in Particular

Water supply is the sum of the amount of rainfall and irrigation water supplied to the soil.

Water consumption is the amount of water used by a plant in building up its body and used in transpiration.

Water losses comprises the amount of water lost by evaporation from the water surface and losses due to leakage in the subsoil, thus natural drainage.

The actual requirement results from these various components.

Just as we supplement the natural supply of rainfall by irrigation, either controlled (technical) or native, in the same way we assist the natural drainage by additional surface or controlled drainage.

The extent to which water losses occur depends upon:

(*a*) evaporation from the free surface,
(*b*) the prevailing subsoil drainage.

Subsoil drainage again is controlled by:

(*a*) the permeability of the soil profile as a whole, and
(*b*) the topographical position of the fields under consideration.

The guiding principle in measuring the amount of irrigation water supplied is of course that of the utmost economy in the use of water resources.

In the second paragraph we saw that drainage is necessary. We can however distinguish between subsoil and surface drainage. When we could reduce subsoil drainage to zero, it would be possible to approach the strictest economy in water use as surface drainage can be controlled easily. Apart from the point whether it is desirable to eliminate subsoil drainage completely, it is not well feasible either.

In various countries such as Indonesia a semi-impervious layer is created deliberately during the preparation of the paddy field, in order to reduce water losses through seepage to the minimum. In many Ceylon soils which as a rule contain a far lower clay content this is not well feasible.

Java :			*Ceylon :*	
0·5 micron	±	50%		
0·5—2·— ,,	±	15%		
Total clay :	±	65%	Total clay (2 micron)	± 30%
2—20 micron :	±	10%	Silt (2—20 micron)	± 10%
Silt + clay :	±	75%	Silt + clay	± 40%

From these figures we can understand why it is so much more easier in Indonesia than in Ceylon to form a semi-impervious layer in the soil ; especially so since the amount of mobile iron and manganese in Ceylon soils is probably considerably lower than in Java soils. And it is these two elements particularly the iron, which contribute to the panformation as they act as a coating material for the finer particles.

Whereas in Indonesia subsoil drainage is reduced and surface drainage takes its place, many Ceylonese paddy soils have an excellent subsoil drainage. Water losses due to subsoil drainage may be considerable. Due to this and the fact that paddy cultivation in Ceylon was first introduced in the dry zone (less than 75″ rainfall a year) by means of highly ingenious and elaborate irrigation systems, surface drainage did not need and consequently did not receive the attention it required in Indonesia.

After the decay of the Anuradhapura and the establishment of the Polonnaruwa Kingdom a further shift to the S. W. of Ceylon occurred. So it is recorded that during the period when Parakrama Bahu was Governor in the South swamps and marshes were reclaimed and transformed into paddy fields in Pasdun Korale (Kalutara District)*.

In this region, however, the rainfall in many cases exceeds 100″ a year. A few cases may illustrate this:

Locality	*Altitude*	*Rainfall*	*Period of observation*
Labuduwa ..	30′ ..	112·69″ ..	21 years
Agalawatte ..	220′ ..	167·62″ ..	14 ,,
Kalutara ..	10′ ..	112·52″ ..	79 ,,

When the rainfall was distributed equally over the year this would not matter very much and subsoil drainage probably could cope with it. However most of the rains come down in showers of high intensity (several inches per hour) as has been observed repeatedly at the

* S. F. de Silva : A *Regional Geography of Ceylon*, 1952.

last two stations mentioned above. And these are the rains with which even the best subsoil drainage cannot cope. In order to prevent calamities of a nature as will be dealt with further on in this paper surface drainage is needed to supplement existing subsoil drainage. This holds especially true where impervious layers occur in the subsoil. So the following profile occurs at the experimental farm Fullerton near Nagoda (Kalutara District):

0 — 8″ peaty topsoil
8″ — 12″ coarse gravelly sand
12″ — 20″ peaty fine sand
20″ — 28″ sand
28″ — 44″ grey sandy clay
44″ — 56″ very stiff bluish-grey clay, impervious
56″ — — coarse sand

Due to the impervious layer at 44″ the peaty layer between 12″ and 20″ came into existence. Later during a serious flood this original peaty layer was covered by coarse gravelly sand, but still the impervious layer at 44″ had its influence and a new peaty layer was formed on top of the sand. At the Labuduwa Experimental Farm a similar impervious layer was found at a depth of only 10″, also resulting in peaty development of the overlying layer. Mr. S. Kandiah observed in river valleys in the Kotmale area that inadequate subsoil drainage resulted in an appreciable decrease in yield compared to adjacent fields with adequate subsoil drainage.

In the Ratnapura District as for instance in the Karapincha region the topography prevents the free drainage of the water accumulating in the subsoil. Here one finds so-called intermontane basins, in which water accumulates.

In all those cases where due to one factor or other free subsoil drainage is restricted *surface drainage* has to give a hand and supplement the subsoil drainage.

Sometimes it is possible to improve upon subsoil drainage in a rather simple way as in those cases where a thin impervious layer occurs near the surface. By digging out or breaking through this layer (often consisting of kaolin) a considerable improvement can be achieved. Cultivators at Makumbara (near culvert 13/7 along the Colombo-Ratnapura road) did this quite successfully.

In cases of topographical obstructions surface drainage, eventually assisted by pumping is the only solution. In this case natural or subsoil drainage is practically zero. But this condition, though it eliminates all uncontrollable water losses by seepage is far from ideal. For successful paddy cultivation we need moderate, slow drainage *through* the soil, supplemented by surface drainage. *The advantage* of surface drainage is that it offers us the possibility of using the excess water drained off over and over again. In using so the amount originally supplied by either nature or men to the highest degree of efficiency, we do exactly what Parakrama Bahu the Great had in mind and left as *the commandment* for the people of Ceylon, when he said: " Let not a drop of water fallen in my Kingdom reach

the sea, without having rendered the highest benefit to my lands and crops." Alas it has to be observed *that the cultivators of Ceylon do not appear to have acted accordingly*, for nowhere in rice growing countries is so much water wasted as in Ceylon.

A six-month paddy crop does not need more than 6½ feet of water, rain and irrigation together, but there are enough places where the farmer uses double this amount of irrigation water alone and nearly treble when one takes the rainfall into account. This waste of valuable water both through seepage and over-irrigation leads up to another aspect of economic use of available water, namely the supply of water.

Due to the rugged topography of the mountain ranges in S. W. Ceylon, the slopes are rather short and steep. And although this type of country is already difficult to handle under natural conditions, deforestations has made things worse. Many catchment areas are badly eroded and ..... erode still, the colour of Ceylon rivers proves this point. It is an exception when a catchment area functions properly, catches the water *and* stores it, only in order to release it gradually. The present situation is that not only showers of high intensity, but all rains rush down the slope of a catchment, carrying with it whatsoever is left of topsoil and accumulated organic matter towards the nearest river.

As a result of the geomorphological development of the S. W. of Ceylon the valleys have gradually silted up and the volume of water they can transport is relatively small. And so many streams and rivers in the S. W., such as the Kelani and Kalu Ganga flood regularly. Areas subjected to flooding are apt to become waterlogged. The only remedy is to devise drainage systems, which take care of the water and make it available where it is needed.

The attention might be drawn to the fact that similar conditions caused the floods in the Tennesse river basin (U.S.A.), till the people decided to do something about it and created the Tennesse Valley Authority (T. V. A.).

Much of the excess water in S. W. Ceylon could be used to the advantage of the dry zone in E. and S. E.—Ceylon. But this requires the projection and building of big channels. From the engineering point of view such a project is entirely feasible.

However such a channel does not exist at present and therefore we cannot go farther than an adequate catchment protection at present. Thus proper soil conservation measures together with adequate drainage facilities, in order to protect the paddy fields at the bottom of the catchment against water calamities. It would exceed the scope of this paper to deal with this matter in more detail.

Erosion of Paddy Fields, particularly of those in S. W. Ceylon

The absence of proper conservation measures and drainage facilities in many catchment areas and paddy tracts in S. W. Ceylon are co-responsible for the sad fact that Ceylon is one of the very few if not the only rice growing country in the world where asweddumized paddy fields are subject to serious erosion.

Erosion of an asweddumized paddy field is loss of clay and silt, both so to say fertility carriers, and are substituted by sand and gravel, resulting in a decrease in both productivity and fertility.

Every shower coming down the catchment slope carries with it much fine gravel, coarse and fine sand and also some clay and silt and last but not least organic matter. The openings in the bunds are not designed to cope with these large amounts of water, nor is the storage capacity of the *liyaddes*, which according to Mr. R. S. Koshals' sample area survey are about a tenth of an acre in Kalutara and a sixth of an acre in Galle District, sufficient for all this water, with the result that it soon rises to the top of the bund and starts to overflow. More than one bund collapses and finally a fast moving stream, which stirs up the topsoil and carries the clay and silt with it, moves over the fields towards the nearest drain and is lost. The paddy field becomes only richer in sand, which in Ceylon is equivalent to sterile quartz sand. In the lower lying *liyadde* one finds in front of the opening in the bund of the adjacent higher lying *liyadde* a large fan of fine and coarse to gravelly sand.

The cultivator is aware of the fact that floods do more harm than good to his fields and therefore endeavours to dispose of the water as quick as possible by laying out drainage channels over the paddy fields, which converge to the opening in the bund, draining in the lower *liyadde*. It might be even possible that this is the cause of the waste of irrigation water, which prevails. In no other place the writer saw water flowing so fast over paddy fields as in Ceylon.

But the cultivators' own practices result many times in loss of clay and silt, thus result in erosion. During the preparation of a paddy field the soil is trampled when the field is flooded in order to bring it in a so-called mudded condition. As long as the cultivator gives this suspension of clay, organic matter and a little silt time to settle down ($\pm$ 4 days — a week) before draining off the water and preparing the field for sowing, no nutrient carriers are lost. Many times however the rains come rather late, and the cultivator starts too late with his operations and cannot afford to wait long enough to let the mud settle down. If however he drains off the field too early much valuable material is carried down to lower fields till finally it reaches the drain and is lost. Unfortunately this is more often the case than not. Probably the only feasible answer will be to make the paddy fields independent by irrigation, such as for instance lift-irrigation.

Summary and conclusions

1. Well drained irrigated paddy soils give higher yields than poorly drained ones. For optimal production paddy requires a good balance between water supply on the one hand and water consumption and water losses due to evaporation, subsoil and surface drainage on the other.

2. The clay content of the paddy soils of Ceylon throughout the wet zone is rather low, as a rule, as compared with the volcanic soils of Indonesia.

3. As a consequence of this difference in clay content no semi-impervious layer is formed by mudding the soil of paddy fields in Ceylon, and this results in considerable losses due to seepage. This is one of the reasons why the actual amount of water used in Ceylon to raise a paddy crop is so much higher than the water requirements of paddy in other tropical rice growing countries.

4. Conservation, and where possible an increase in the clay content of wet zone paddy soils, are synonymous with conservation of or increase in soil productivity and fertility respectively.

5. In order to prevent any further decrease in clay and silt content of paddy soils caused by the increased run-off after heavy rains, the introduction of suitable and adequate conservation practices in the catchments is urgent.

6. Surface drainage should receive more attention not only in those areas mentioned, but especially in those areas where due to topographical factors or profile characteristics, subsoil drainage is restricted.

7. The measures indicated under (5) and (6) can be linked up with irrigation systems and so more rainfed paddy land will become irrigable and give higher yields.

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Oxidation-Reduction Potentials in Rice Soils – Trends in a Dry Zone Field

C. R. PANABOKKE

Introduction

THE earliest work on the study of oxidation-reduction potentials developed in soils was that of Gillespie (1) in 1920. Aspects of this subject have been taken up at various times by different workers, and in some instances their findings have had practical application. The better known investigations are those of Bradfield, Batjer, and Oskamp (2) and of Peech and Batjer (3) on the relation of the oxidation-reduction potentials to fertility in orchard soils, and the work of Pearsall and Mortimer (4) whose findings have been successfully exploited by the Japanese in the manuring of rice by the deep placement of ammonium sulphate. A recent publication on oxidation-reduction potentials carried out in rice soils is that of De Gee (5), where reading were taken *in situ* in a field with rice plants two months old, in order to test the theory regarding the formation of a " sawah " profile (Koenigs, 6).

In the studies carried out in 1952-53, in a rice field at the Agricultural Research Station, Maha Illuppalama, oxidation-reduction potential measurements were made at points down the depth of the profile, at various intervals, starting from the time just prior to transplanting (i.e., a fortnight after flooding). These studies show the trends in depth zonation of the oxidized and reduced layer with time, and suggest certain modifications in the present practice of the application of top dressings of ammonium sulphate.

Theoretical Considerations

A definite potential difference exists between an unattackable platinum wire and a solution containing a mixture of oxidant and reductant which can be brought into a reversible equilibrium. The theoretical expression that equilibrates an oxidation-reduction potential and the system it represents is given by the relation : $E_h = E_o - \frac{RT}{nF} \text{ in } \frac{(\text{oxid})}{(\text{reduc})}$ where E_h = potential in volts referred to the normal hydrogen electrode as zero of the system under consideration,

E_o = constant characteristic of the system,
R = Gas constant,
T = Absolute temperature,
F = Faraday = 96500 coulomns,
n = number of electrons involved in change from oxidized to reduced form,
(oxid) = concentration of oxidized form,
(reduc) = concentration of reduced form.

The electrometric method of measuring this potential consists in building an electric cell in which the system under study is made one half cell, and the other half is any standard cell. The unknown half cell has an unattackable platinum electrode immersed in the system under study. The two half cells are connected by an electrolytic bridge and the electric potential is measured by a potentiometric set up.

The accurate determination of the potential of a soil system is a difficult procedure because the soil is very heterogeneous and contains several distinct oxidation-reduction systems, some of which poise only with difficulty in the presence of biological catalysts. On account of the presence of iron in all soils, one could interpret all potentials of the soil system in terms of the system $Fe^{+++} + e \rightleftharpoons Fe^{++}$ But one cannot avoid the possibility of other systems participating, some of which exist in the colloidal condition and contain many kinds of organic matter oxidizable to different extents. However, in a well-aerated soil where the $Fe^{+++} + e \rightleftharpoons Fe^{++}$ system predominates, the theoretical formulations will hold quite well. Yet the measurement of oxidation-reduction potentials in a paddy soil by a method where the system can be well poised would be very useful.

Experimental Procedure

Gillespie (1) measured the oxidation-reduction potentials of water-logged soils by allowing the platinum electrodes to remain in the soil covered with water and measuring the potential each day. Brown (7) allowed the platinum electrode to remain in contact with a soil-water mixture of fixed ratio, and employed centrifuging of the system to bring about better contact, after which the potential was measured. Both these methods were tried out, but proved unsatisfactory as potential drifts were observed in all cases which had no regularity in behaviour to permit a system of standardization. The measurement of the potential of a water-logged soil when suspended in 0. 1 N sulphuric acid proved to be the most satisfactory as the systems were well poised at this pH, and hardly any potential drifts were observed after standing for 30 minutes. As all results were to be transformed to the E_h at (pH = 7) scale, the pH – E_h relationship was determined by measuring the Eh at various pH values of the soil in 0. 1 N sulphuric acid. A pH – E_h slope of 0.07 volts per unit change in pH was obtained, which held constant for the soil at all respective depths down the profile.

The platinum electrodes which were cleaned with hot chromic acid, rinsed in distilled water and heated over an alcohol flame, were placed in the 0. 1 N sulphuric acid soil suspension, and the tube containing the soil was well tapped to ensure good contact between the soil and the platinum electrode. After standing for 30 minutes contact was made with a standard (silver/silver chloride) electrode through an agar bridge and a potentiometric set up, which measured the electric potential of the cell. A pH determination was also made of every sample after the E_h determination, and the E_h was corrected to E_h at pH = 7. The soil samples were collected in the field from the respective depths down the profile into small, darkened, air-tight bottles with minimum delay. The manner of drawing the sample was to scoop out a soil monolith lying between two points

(say 5—7 cms. from the surface) with the aid of a spatula from a freshly cut face of the profile, and the E_h value of the sample from this zone is designated to that at a point 6 cms. from the surface. The surface samples were taken by gentle superficial scooping of the surface.

From a field which was transplanted on November 24, samples were taken on November 23 (i.e., a day prior to transplanting) and again on December 8, to a depth of 100 cms. down the profile. Thereafter samples were taken to a depth of only 15 cms. on the following dates:—December 27, January 3, January 11, January 20 and January 27. A shortage of irrigation water due to failure of rains curtailed progress beyond this stage.

Results and Discussion

Readings taken on November 23 and December 8, 1952, which are represented in curves A and B of Fig. 1, show the trend in the building up of the oxidation-reduction potential profile at the early stages. An increase in value of the surface layer from a potential of -10 millivolts to $+50$ millivolts, together with an overall increase in the oxidation-reduction potential over the whole length of the furrow slice, has occurred within the period of the first two weeks. The shape of the curve also indicates that oxidative conditions prevail below the furrow slice. Such oxidative conditions could be associated with good sub-soil drainage.

In curve C (Fig. 2) which represents the reading on December 20, it is observed that the potential of the surface has increased to a value of $+290$ millivolts. The above trend in the development of the oxidation-reduction potential curve could, to a certain extent, be explained on the existing knowledge of the behaviour of paddy soils. When a paddy field is flooded with irrigation water, the microbiological balance in the soil is considerably altered. Under the resulting anaerobic conditions, the heterotrophic organisms which decompose organic matter and consume oxygen, give rise to reduced conditions in the puddled section of the furrow slice. In course of time, however, the water which is charged with oxygen both from the atmosphere and from the hydrophytic plant associations, influences the uppermost layer of the paddy soil, and conditions favourable for the growth of the autotrophic organisms in this layer result. The enhancement of the autotrophic activity with time is reflected in the rate of building up of the oxidation potential of this layer.

It is known that when ammonium sulphate is applied to the surface of the paddy field the ammonium nitrogen is oxidized to the nitrate nitrogen by the aerobic organisms. This nitrate nitrogen on leaching downwards undergoes de-nitrification by the anaerobic organisms and ultimately escapes as free nitrogen. From the trend in the oxidation potential values so far observed, it appears that the oxidation of ammonium nitrogen at the surface which will be slow in the initial stages, would be greatly intensified with time. A cultural practice which could incorporate the ammonium sulphate in the reduced section of the furrow slice, at the time of application of top dressing, is accordingly desired.

The determinations made on December 27, 1952, January 3, 11, 20 and 27, 1953, cover the period between the phase of tillering and the phase of initiation of inflorescence primordia, and are represented in curves D and E (Fig. 2), F, G and H (Fig. 3). The sequence indicates a breaking up of the furrow slice into several zones where alternate oxidative and reductive conditions prevail.

Evidence supporting the view of a downward diffusion of oxygen (8) may be found in the overall rise in the oxidation potential of the reduced layer. In the early stages, under the prevailing conditions of equilibrium, the furrow slice is composed of a thin superficial oxidized layer and a broad reduced layer beneath it. This situation gradually undergoes transformation on account of certain other operative factors asserting their influence. The diffusion of oxidative substances from the roots of the rice plant (9) will influence the equilibrium in the reduced section of the furrow slice. Moreover, a peculiar development of the profile in the flooded furrow slice of a paddy soil (8), explainable on the principle governing the Liesegang phenomenon, where a downward diffusion of oxygen followed by certain physico-chemical changes ultimately results in the formation of thin bands of ferric hydroxide down the profile, is corroborated by the evidence borne out in the shape of the curves: D, E, F, G and H.

Conclusions

In the development of the oxidation-reduction potential profile, certain factors manifest themselves. Microbiological activity is followed up by the diffusion of oxygen from the surface of the soil and from the roots of the rice plant. These processes running parallel to each other and acting in unison, give rise to a system of equilibrium initially simple and finally complex.

An increase in the value of the oxidation potential of the surface layer with time is observed. The importance of incorporating the ammonium sulphate in the reduced zone of the furrow slice at the time of the top dressing is indicated.

Acknowledgements

The author is grateful to Dr. M. F. Chandraratna at whose request this investigation was undertaken. He is also indebted to Mr. E. Abeyratne for his valuable suggestions throughout the course of the investigation, and to Mr. T. Kanthasamy and Mr. N. Kanaganayagam for their help in carrying out the experiments. Thanks are also due to Dr. Devanadan of the Physical Chemistry Department of the Ceylon University for the loan of apparatus and accessories.

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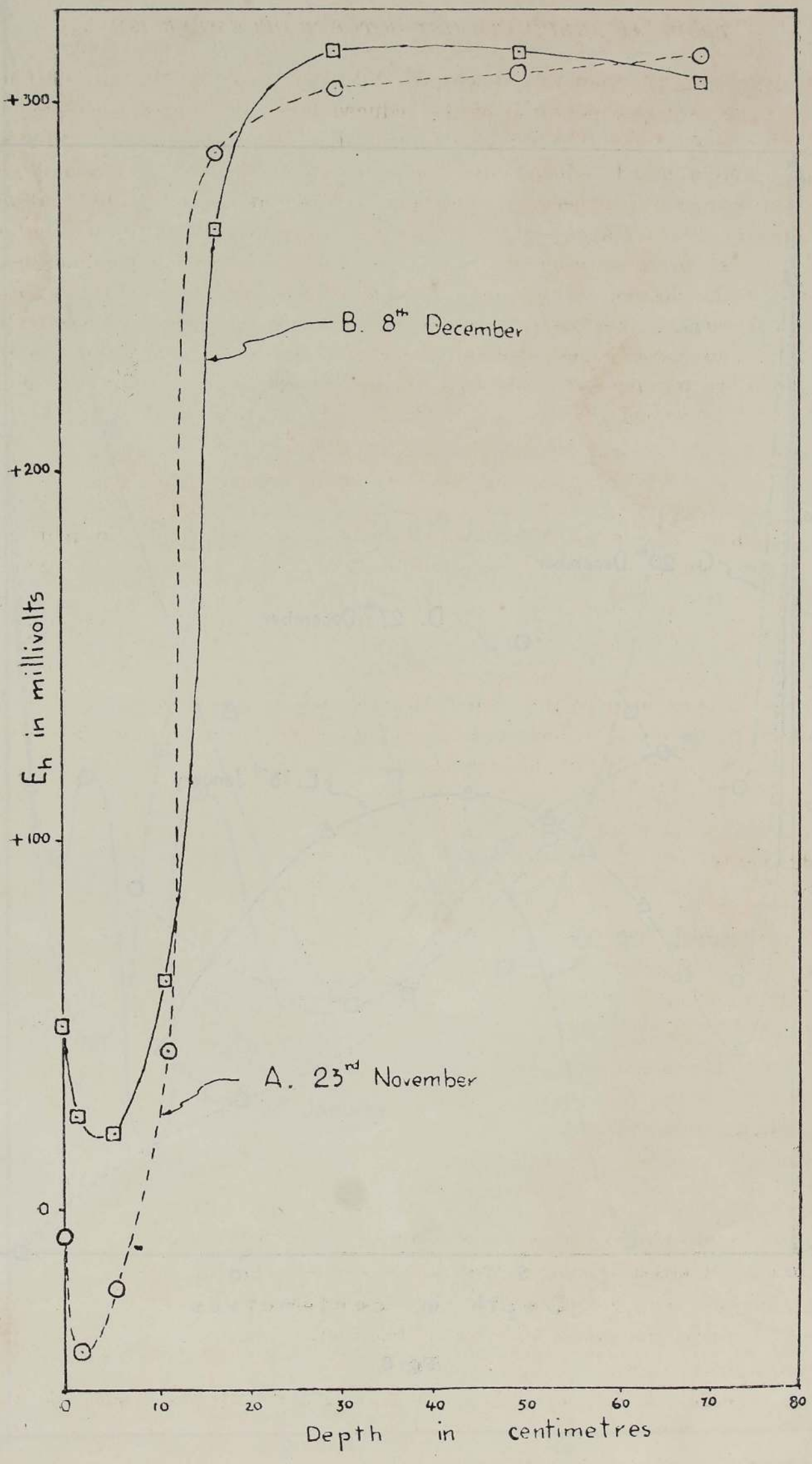

Fig. 1

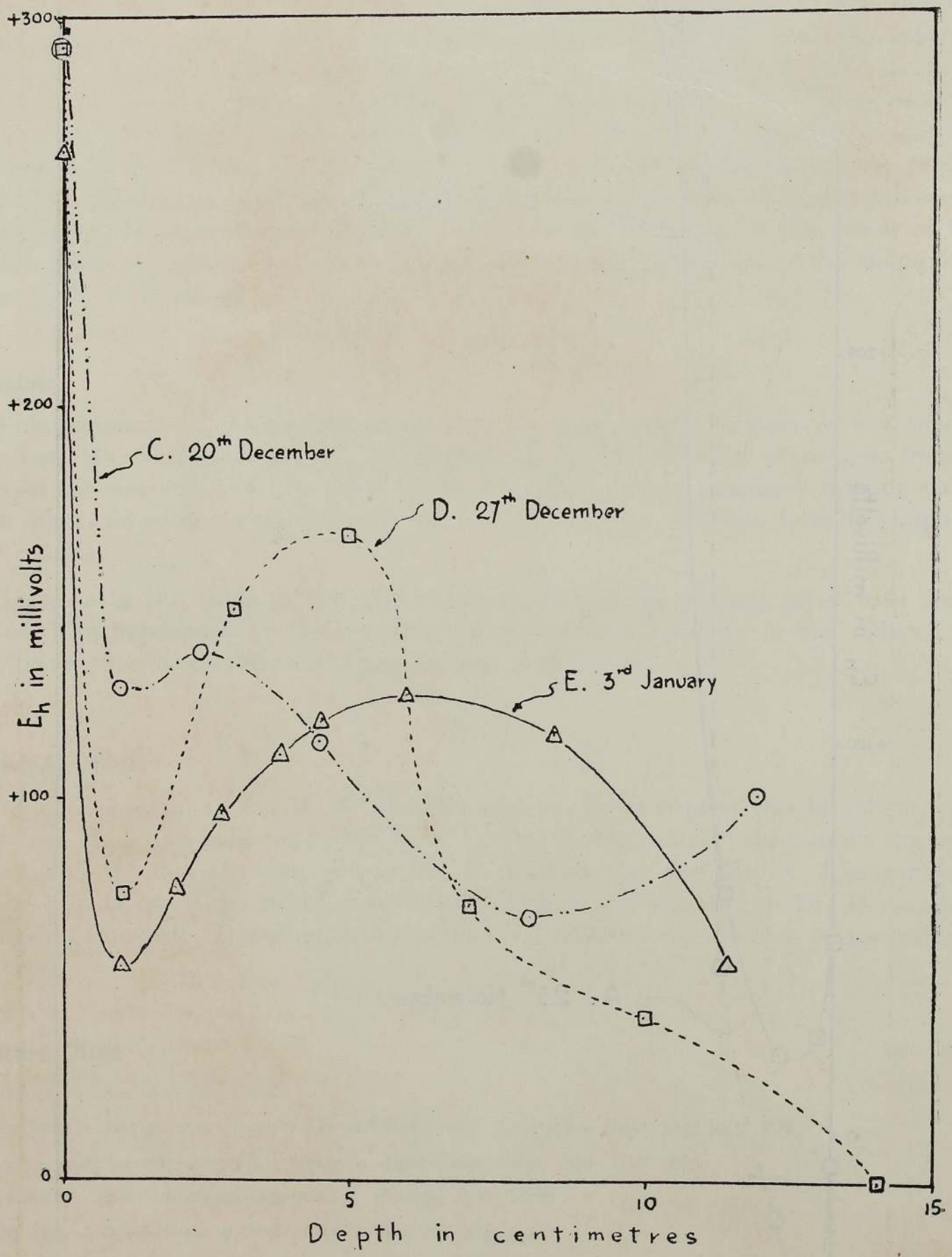

Fig. 2

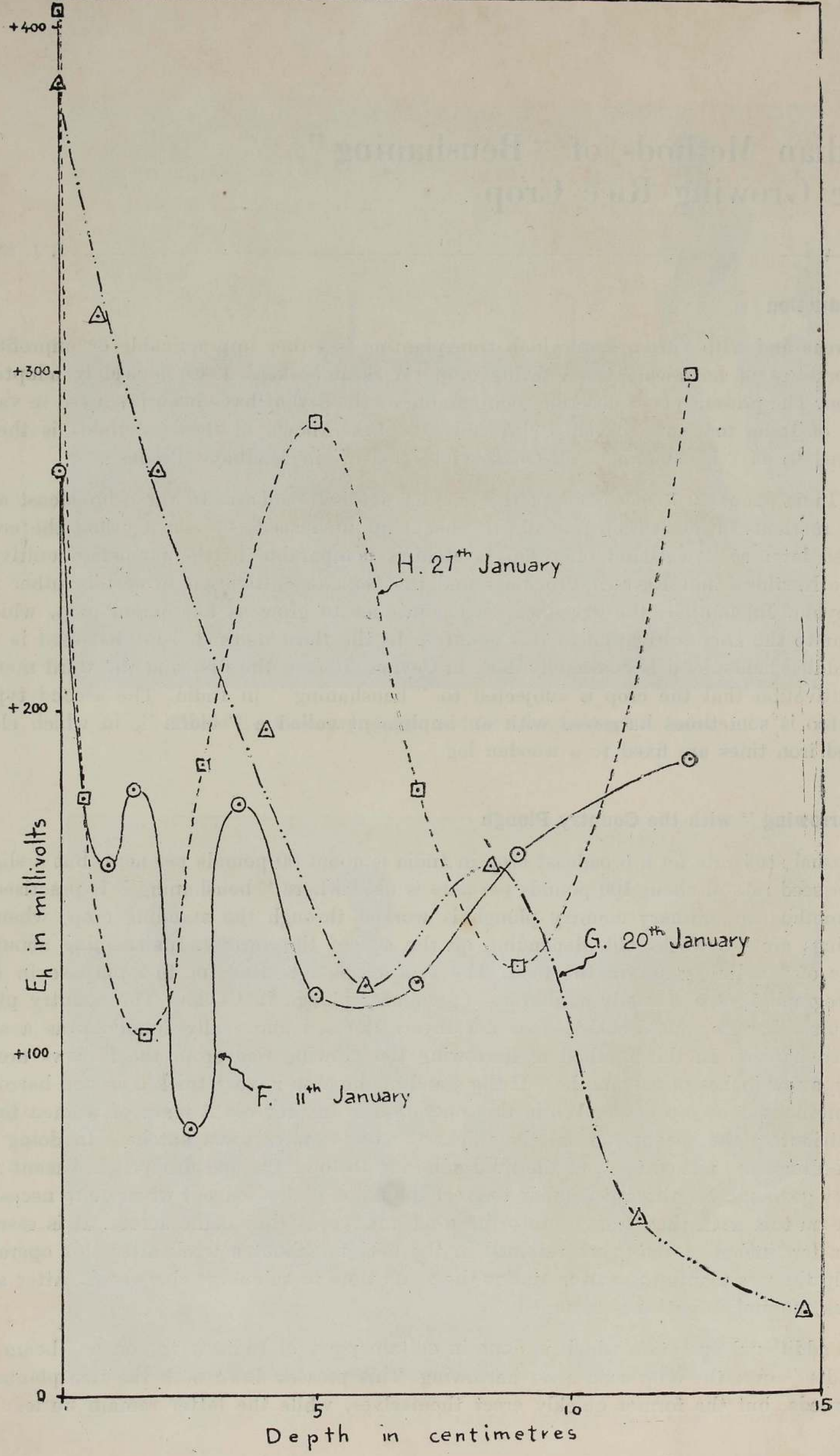

Fig. 3

Indian Methods of "Beushaning" the Growing Rice Crop

J. J. NILES

Introduction

IN areas and with varieties in which transplanting is either impracticable or unprofitable, the practice of harrowing the growing crop (Wickramasekera 1940) is widely adopted in Ceylon. The present paper describes comparable methods that have been practised in various parts of India for many decades. Probably the best known of these methods is the one referred to as " beushaning " in Orissa and " biasi " in Madhaya Pradesh.

In India about 70-75 per cent. of the rice acreage is broadcast. In these broadcast areas, three methods of cultivation prevail. In one unsprouted seed is sown dry and the crop is treated later as a wet-land one. This system is comparable to the *manawari* cultivation in the Northern and Eastern Provinces and the *kekulan* cultivation in certain other parts of Ceylon. In another, the dry-sown seed continues to grow as an upland crop, which is similar to the *elwi* cultivation in this country. In the third method, sprouted seed is sown in puddled fields, as it is commonly done in Ceylon. It is in the first and the third methods of cultivation that the crop is subjected to " beushaning " in India. The second type of crop too is sometimes harrowed with an implement called a " bidha ", in which closely spaced iron tines are fixed to a wooden log.

" Harrowing " with the Country Plough

The usual seed rate for a broadcast crop in India is about 80 pounds per acre, but a slightly higher seed rate of about 100 pounds per acre is used where " beushaning " is practised. In this method an ordinary country plough is worked through the standing crop, when the seedlings are 4-8 weeks old, depending on the age of the variety, maintaining about 3-4 inches of standing water in the field. The type of plough used for this purpose in India (Photograph 1) is essentially similar to the country plough in Ceylon. The country plough of course, has no mould-board, does not invert the soil and really functions as a single toothed harrow. In this method of harrowing the growing rice crop, the furrows are run within a few inches of one another. If the stand of the crop is very thick a second harrowing is sometimes done crosswise. While this operation is in progress a team of women follow, re-distributing the seedlings from the thicker to the thinner sown patches. In doing this, the seedlings are picked up with the mud adhering to the roots and dropped in vacant spots as they go along. No attempt is made to erect the fallen plants, except when quite necessary. While on this work they trample into the mud any weeds they come across. It is essential that a few inches of water are retained in the field for about a week after this operation, to help the rice plants to recover and at the same time to submerge the weeds. After about a week, normal irrigation is resumed.

An additional operation which is done in certain parts of India is to run a " beam " or " ladder " over the crop soon after harrowing. This presses down both the rice plants and the weeds, but the former quickly erect themselves, while the latter remain buried. This

PHOTO 1.—A country plough used for " beushaning " in India.

PHOTO 2.—Type of " beam " or " ladder " used for burying weeds after harrowing.

implement, which is more commonly used for levelling the soil, is made up of two parallel beams, each about 6 ft. long × 3½ in. broad × 1½ in. thick, fixed together with a 6 in. space in between them. The implement is similar to that shown in photograph 2. It is worked by a man with a pair of bullocks. In place of this implement, cultivators more often use two bamboos tied together. If necessary the operator rides on the " beam " to give added weight.

Green Manuring Simultaneous with " Beushaning "

A refinement of the " beushaning " technique is the sowing of Daincha seed (*Sesbania aculeata* Pers.) at the rate of 10-15 pounds per acre mixed with the seed paddy (2). As a result of harrowing the standing rice crop, most of the Daincha plants die and those that survive are pulled out and trampled into the mud. The subsequent operation of " beaming " further helps to bury in the Daincha plants more completely. This crop of Daincha produces about 5,000 pounds of green material per acre, when 4-8 weeks old and provides a very good green manure. Daincha has been found useful to reclaim saline lands where other green manure crops will not grow. It is also said to be drought resistant and able to withstand wet conditions (3).

Advantages of " Beushaning "

Varieties that have a sowing-to-harvest duration of less than four months are generally not subjected to " beushaning ". Practically all varieties are stated to benefit by " beushaning " and no differential varietal response has been recorded (4). Top dressing with sulphate of ammonia, if considered necessary, is done at the time of " beushaning ".

This technique facilitates weed control and thins the crop, but all the factors that contribute to the response of this treatment are not fully known. It can be said that one of the factors which gives particular benefit is the incorporation of the surface growth of blue-green algae into the soil. Pearsall (5) has shown that when rice soil is submerged or water-logged, reductive conditions develop and that only the surface layer in contact with air or oxygen-containing water is oxidative. In the flooded rice soils of the tropics luxuriant growth of nitrogen-fixing blue-green algae occurs in the oxidative layer. Hence this surface layer becomes enriched with quantities of easily decomposable organic matter, composed of the cells of living and dead algae. When " beushaning " or similar operations are done, the mixing of the soil layers would, according to Japanese workers, incorporate the easily decomposable organic matter of the oxidative layer into the reductive mass, where it is quickly decomposed by the heterotrophic micro-organisms. As a result, much ammonium nitrogen is produced.

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Phosphatic and Nitrogenous Manuring of Paddy in the Southern Division

D. V. ARIYANAYAGAM

Response to Phosphatic Fertilizers

MANURIAL trials carried out at various stations in this division have shown that paddy responds to phosphatic fertilizers differently at different stations. At Ambalantota Paddy Station four kinds of phosphates (viz., superphosphate, hyperphosphate, saphos and magnesium phosphate) applied at the rate of 30 lb. phosphoric acid per acre for a period of three years (six seasons) had no direct, residual or cumulative beneficial effect on the yield. No response was obtained even in the presence of high levels of nitrogen. At Tissamaharama Paddy Station, superphosphate gave a steady increase in yield of 12 per cent. during the same period. The response was mainly direct. At Udukawa Paddy Experiment Station in the Matara District, a manurial trial was commenced only in *yala* 1953 but the growth of the paddy crop already indicates a very striking direct response to superphosphate.

Response to Nitrogenous Fertilizers

With regard to nitrogenous fertilizers, experiments carried out at Ambalantota Paddy Station for the last five seasons have clearly shown the benefits of manuring the paddy crop with sulphate of ammonia. In the *maha* season the highest yield was obtained by the application of 400 lb. per acre. 100 lb. per acre gave an increase of nearly 20 per cent. over control, and every subsequent 100 lb. gave a further increase of approximately 10 per cent., so that the application of 400 lb. per acre increased the yield by nearly 50 per cent. In the *yala* season, however, the most economical level was found to be 200 lb. per acre, which increased the yield by about 30 per cent. Further appreciable yield increases were not obtained by levels higher than 200 lb. per acre.

Calcium cyanamide proved to be much inferior to sulphate of ammonia at Ambalantota Paddy Station for the last two seasons ; but the growth of the paddy crop this season (*yala* 1953) indicates a definite superiority. The cyanamide-manured plots appear to have made better growth and are darker green in colour than those manured with an equivalent amount of sulphate of ammonia. Response to calcium cyanamide, therefore, seems to be cumulative.

Extra Response to Nursery Manuring

The advantages of manuring the nursery with a complete fertilizer mixture was clearly demonstrated in a trial carried out at Tissamaharama Paddy Station in *maha* 1952/53. Nursery manuring alone (i.e., without field manuring) gave a yield increase of 13 per cent. over control ; field manuring alone (i.e., without nursery manuring) gave an increase of 26 per cent. ; whereas both nursery and field manuring increased the yield by 36 per cent.

BOOK REVIEW

Milk Pasteurization—Planning, Plant, Operation and Control

Prepared by

H. D. RAY, J. R. CUTTEL, H. S. HALL,
A. T. R. MATTICK AND A. ROWLANDS

F. A. O. Agricultural Series No. 23 and W. H. O. Monograph Series No. 14

PASTEURIZATION of milk is now firmly established as a necessity. It must now be accepted that no raw milk can be considered quite safe because even if diseases are eradicated from our cows there is still fortuitous infection from human and other sources to consider.

The perishability of *raw* milk calls for frequent delivery with corresponding higher cost and limits the distance over which milk may be transported for sale. Processes which reduce perishability such as pasteurization and refrigeration are therefore of great value in decreasing milk distribution costs and in enlarging the markets. The latter holds good in the tropics more than anywhere else, and it is well known that one of the main reasons for the very low consumption of milk in Ceylon is the absence of proper facilities for marketing the milk actually produced.

This publication gives a good account of the development of pasteurization and goes on to describe in detail modern methods of pasteurization, equipment and buildings, &c., in common use. Methods of milk control, their importance and legislation are also well described.

The publication which is very well illustrated is certain to be of considerable value not only to those who are engaged in this important section of food preparation but also to those who are generally interested in milk production and its proper utilization. It ought to find a large number of readers also in this country.

A. V. A.

RESEARCH NOTES

Toxic Effects of Feeding *Indigofera Endecaphylla* (JACQ) to Calves

REFERENCES to literature show that in Hawaii, feeds containing 50 per cent. of *Indigofera endecaphylla* (Jacq) fed to cattle cause an increase in the incidence of premature births, dead foetuses and calves which die within a few hours after birth. In unbred heifers there was anorexia, loss of weight, lower conception rate, abortion and nervous symptoms.

In sheep the symptoms of toxicity due to feeding this legume were decreased appetite, corneal opacity, loss of weight, general weakness, unsteady gait, abortion, diarrhoea, purulent nasal and serious ocular discharge and death.

In Ceylon cattle and goats are known to graze on lands where this legume is grown as a mixed cover crop and no ill effects are reported. But with these animals the quantity consumed is well below the amount fed in experiments, and besides they are never on this legume for a sufficient period to develop toxic symptoms.

At the Veterinary Research Laboratory, Peradeniya, daily feeding two six-month old Sinhala bull calves with 10 lbs. of this legume and 20 lbs. grass for 2 weeks caused loss in body weight, increase in the output of indican and the presence of albumin in the urine. Histopathological study showed that there was early damage to the liver and kidneys.

Hormones from the Dung of Pregnant Cows

IN a previous issue of this journal we mentioned that intramuscular injection of an extract from the dung of a pregnant cow induced oestrus in two out of four cows treated. Since then this product was tested in the field and the results are as follows :—

(1) At the Mahaberiatenne Estate Dairy Farm, three heifers and one cow were each given 25 c.c. of the extract intramuscularly. Oestrus was noticed in the cow and two of the heifers within two days of administration. In case of the heifer which did not respond to treatment a second dose of 25 c.c. was given and heat was observed on the second day after the administration. All the animals were served when they were in full heat. Rectal examination after two months showed that the services were successful in the three heifers.

(2) At the Veterinary Research Laboratory two cows were each given 20 c.c. of the dung extract. There was no response for six days. A second dose of 20 c.c. was given again to each of them. One cow came into heat on the second day and the other on the seventh day after administration.

(3) At the Animal Breeding Centre, Nikaweratiya, three cows were each given 20 c.c. of the dung extract. One cow came into heat on the third day.

(4) One old cow at Pelwehera did not respond to two injections of 20 c.c. of the dung extract given at weekly intervals.

From the observation made at Mahaberiatenne Estate Dairy it is evident that the extract from the dung of pregnant cows besides producing oestrus can also cause ovulation in the bovine. Purification and standardization of the product are necessary before we can recommend an effective dosage for cows of different ages to achieve such results.

P. JEGANATHAN.

An Outbreak of Listeriosis in Goslings

LISTERIA MONOCYTOGENES, the casual agent of Listeriosis, is almost world-wide in its distribution and is recognized as a pathogen for a number of domestic and wild animals and man.

The clinical picture and pathological lesions due to infection with this organism varies with the species of host. In the higher mammals it gives rise to an encephalitis or a meningitis, whereas in laboratory animals and birds it gives rise to a generalized infection.

In Ceylon, *L. monocytogenes* has recently been recorded as the cause of heavy losses in a batch of goslings. These birds, belonging to the School of Agriculture for Girls, Kundasale, were hatched out locally from eggs imported from England. Deaths began to occur when the birds were about 3 weeks old. Apart from a gradual loss of condition, no definite clinical symptoms were seen.

Out of nine goslings autopsied, *L. monocytogenes* was isolated from the heart-blood and/or liver of six. Minute necrotic foci in the liver were seen at autopsy.

One gosling sent alive to the laboratory showed a marked lateral curvature of the neck, and tended to walk in circles. This bird was sacrificed for post-mortem examination and *L. monocytogenes* was isolated from its brain, although no mycroscopic lesions were seen in this organ.

It is interesting to note that Listeriosis has not been recorded before in geese or any other water-fowl, and that nervous symptoms due to infection with *L. monocytogenes* have never been recorded in birds. This is also the first recorded outbreak of disease due to this organism in Ceylon.

The strain isolated conformed to the classical description of *L. monocytogenes*. It was found pathogenic to mice, rabbits and chicks, showing characteristic lesions at autopsy.

Most of the reported outbreaks of Listeriosis in birds have been in association with other debilitating factors.

Transmission experiments reveal that birds have a high degree of natural resistance to the organism, and large doses of the organism are required to set up experimental infections.

The present outbreak occurred among goslings hatched out locally from imported eggs. Such birds are generally on a lower plane of resistance and this probably explains why the goslings alone were affected whereas local chicks, brought up under identical conditions in adjoining brooders remained unaffected.

A. BANDARANAYAKE.

Internal Fixation of Femoral Fracture by Intra-Medullary Pinning

This article is a record of the first case in Ceylon of intra-medullary pinning to immobilize a fracture in a dog.

A complete, slightly oblique fracture had been detected in the upper third of a femur, with much over-riding and displacement of the ends of the fractured bone. Intra-medullary pinning had been resorted to on account of the difficulty of applying external splints to the thigh of dogs. The operation was performed two days after the accident. The pin had been left *in situ* for twenty-two days. The animal was able to make normal use of the limb within a period of a month.

The writer is of opinion that this surgical operation is simple and reliable, and relieves the surgeon and the owner of undue aftercare and attention which are required when external splints are applied. The dog tolerates the pin well.

G. E. KODITUWAKKU,
(Abstract from C. V. J. Vol. 1 No.2.)

MEETINGS

Central Board of Agriculture

Proceedings of the Fourth Meeting of the Central Board of Agriculture held in the Board Room at the Royal Botanic Gardens, Peradeniya, on 21st September, 1953

Dr. A. W. R. Joachim, Director of Agriculture, presided and the following were present:—Mr. C. A. M. de Silva (Vice-Chairman); Mr. M. Sri Khanta, C.C.S., Director of Land Development; Mr. N. Manicka Idaikkadar, C.C.S., Director of Food Production; Mr. A. W. R. Perera, Assistant Commissioner for Development of Marketing; Sir James P. Obeysekera; Mr. S. Pararajasingham; Mr. A. M. Clement Dias; Mr. R. T. Chelliah; Mr. R. H. de Mel; Mr. Marcus S. Rockwood; Mr. Thomas Amarasuriya, Mr. S. Pathmanathan, Chairman, Low Country Products Association; Mr. N. H. Keerthiratne, M.P., and Parliamentary Secretary to the Ministry of Posts and Information; Mr. U. B. Dedigama, M.B.E., R.M.; Mr. Arthur D. S. Jayasinghe; Mr. S. L. Bandara Dharmakirthi, J.P.; Mr. Sydney Ellawala, J.P.; Senator C. Wijesinghe; Mr. A. D. Paranavitana; Mr. Henry Abeywickrema, M.P.; Mr. T. C. Rajaratnam, J.P., U.M.; Mr. J. M. Sabaratnam, D. R. O., Mannar; Mr. K. Kanagaratnam; Mr. S. M. Rasamanickkam, M.P.; Mudaliyar N. M. Abulcassim Marakar; Mr. W. M. Cumaraswamy; Gate Mudaliyar N. Wickremaratne; Sam A. I. Elapate Dissawa, J.P., U.M.; Mr. H. Ashmore Pieris; Mr. H. Abeygoonesekera, D. R. O., Wellassa; Mr. S. Sivapalan; Mr. Kenneth Morford, C.B.E., J.P., U.M.; Mr. A. T. Sydney Smith, J.P., U.M.; Mr. R. Singleton Salmon, M.P.; Mr. S. A. Selvanayagam; Mudaliyar M. M. Ebrahim, M.P.; and Mr. M. Sivanathan, C.C.S., Secretary, Central Board of Agriculture.

The following officials of the Department were present on invitation:—Dr. W. R. C. Paul, Assistant Director (Technical); Mr. C. R. Karunaratne, Agricultural Officer, Dry Farming; Mr. E. Abeyratne, Agricultural Research Officer, Dry Farming.

The following visitors were also present:—Mr. S. B. Yatawara, Agricultural Officer (Propaganda); Mr. M. R. M. Jebaratnam, Assistant Agricultural Officer, Propaganda; Mr. A. H. Imhof (F.A.O.); Mr. L. S. C. Canagasingham; Mr. D. Nillegoda; Mr. H. Wickremasinghe; Mr. S. E. G. Salgado, Lecturer, School of Agriculture, Peradeniya, and Mr. K. Arthur Perera.

Letters and telegrams regretting inability to attend the meeting were received from the following:—Miss Cissy Cooray; Mr. Justin Kotelawala; Mr. H. E. Tennekoon, Land Commissioner; the Director, Coconut Research Institute; Mr. L. S. Boys; Dissawe H. B. Rambukwelle, M.P.; Major E. C. de Fonseka; Mr. A. Hensman; Mr. Gladwin Kotelawala; Mr. A. H. T. de Soysa; Mudaliyar S. Armstrong; Sir Wilfred de Soysa; Mr. G. K. Newton; Mr. N. Rajavarothiam, M.P.; Mr. S. H. Mahadiulwewa, M.P.; Mr. H. B. Samarakoon; Mr. A. C. Ponnambalam; Director of Rural Development; Mr. A. Perumayanar; Mr. M. Senanayake, M.P.; Mr. T. B. Naranpanawe, D. R. O., Ipolegama; Mr. P. B. Bandaranayake; Director of Irrigation and Mr. K. W. Devanayagam.

I—Confirmation of the Minutes of the last Meeting

The minutes of the third meeting of the Central Board of Agriculture were unanimously confirmed subject to an amendment moved by Mr. A. M. Clement Dias, namely, that on page 19 of the minutes, last but the 3rd line, the figure 36 be substituted by the figure 18.

Chairman—" I must express my apologies to you all that there have been three postponements of the date of this meeting. I must take the responsibility for it, although the postponements have been beyond my control. The first date fixed was one which coincided with a meeting of Parliament and a Member of Parliament who was very interested in dry farming wrote in to say that as he would like to participate in the discussion he would wish the meeting postponed. I felt that it would be unfair by a number of Members who would be similarly placed if I did not accede to this request, and agreed to it. On the second occasion, the meeting was fixed for the 7th September which happened to be the date of the Prize-giving at the Girls' Farm School, Walpita, at which the Prime Minister was to preside, and accordingly I, as Head of the Department, had to be in attendance. On the 3rd occasion the meeting was fixed for the 14th September. This coincided with the Arunachalam Centenary Celebrations and a number of members wrote in and asked for a postponement of the meeting. At first I regretted that no postponement was possible but there were so many members requesting it, and in memory of a great man whose centenary was being

celebrated, the meeting was postponed again. That is the reason why we find ourselves here today after three successive postponements and I offer members my apologies for any inconvenience caused.

In the future I think it would be desirable for us to fix the date of the next meeting before we adjourn.

II—Leave of Absence

The Chairman said that two members of the Board, Miss Cissy Cooray and Mr. A. Hensman, have applied for leave of absence from Board meetings. Miss Cissy Cooray had left for America and would be back by the end of November and Mr. Hensman has applied for six months' leave. Leave of absence was accordingly granted.

The Chairman also stated that some members had complained about the non-receipt of the Agenda of the meeting. He said that the notice of the meeting and the agenda were sent out together, and as there was only one item in the agenda some members had probably overlooked this. He expressed regret if any member had not received a copy by error.

III—Matters arising out of the Minutes

" Regarding action taken on the earlier proceedings of the Board " the Chairman stated " we have had, apart from the inaugural meeting, two meetings of this Board at which we discussed the subjects of Food Production and Animal Husbandry. The minutes of the meeting on animal husbandry has only just been confirmed and therefore no action has been taken on these recommendations but in regard to the discussion on Food Production, the position is that I forwarded to the Ministry a copy of the full proceedings of our meeting and had a summary drawn up of the important suggestions and proposals made by members. This was done for easy reference and sent to the Ministry for their consideration. It is receiving their attention. We have had an interim reply, on some points but no finality has yet been reached. All I can tell you is this that all our deliberations are being considered by the Ministry and, so far as I am concerned I have made it my special duty to report in full the proceedings and also draw attention to specific proposals made by various members on the different subjects that were discussed. The Minister will now have a full resume of all the proposals that have been submitted on this subject. I hope that when we meet next I shall be in a position to report further on the matter ".

Mr. R. Singleton Salmon, M.P., inquired whether it would be possible to circulate among members copies of the summary of proposals made at meetings which had been sent to the Ministry.

The Chairman agreed to this request.

Chairman—" The main item on the agenda today is a discussion on Dry Farming which will be initiated by the Agricultural Research Officer, Dry Farming, Mr. E. Abeyratne and Mr. C. R. Karunaratne, Agricultural Officer, Dry Farming. Before we start the discussion on Dry Farming I would like, very briefly, to say a few words by way of introduction to this subject.

Dry Farming as you know is not a new line of work in this Department. I have been looking up records on this subject and I find that experiments on Dry Farming date back to 1903. These experiments were started by the Director at that time, Dr. John Willis, and continued by his successors in office. Curiously enough the first Research Station started for dry farming was at Maha Illuppalama, which has again become our Dry Farming Research Station. The original station was closed down in 1919 for some reason or other. But in 1944 it came back to Government having in the meantime been used for the purpose of a sisal-hemp plantation. The Department had all along kept in mind the importance of working out a system of agriculture suited for the dry zone under normal rainfall conditions. In the course of years stations were started in various parts of the country. Apart from Maha Illuppalama, there are stations at Anuradhapura, Jaffna, Ambalantota, Nalanda, Middeniya, Bata-ata, Vavuniya, Unichchai and Polonnaruwa, but most of these were centres where simple experiments were carried out over the years. They gave us extremely valuable information, though not of a precise nature. That was the position till about 1938. Then Mr. Edmund Rodrigo, one of my predecessors, got the happy idea of initiating a dry farming experiment, not from the investigational point of view but from the development point of view. He set up a small dry farming colony of about 100 acres extent. Mr. Karunaratne, of course will give you the whole history of it and will tell you what is being done. From 100 acres this area blossomed out to 700 acres. Mr. Edmund Rodrigo started

his experiment at a place called Kurundankulama, about 4 miles from Anuradhapura. The traditional system of dry farming as you know in Ceylon, is the chena system and it has been the constant endeavour of the Department to replace this system by a more permanent system of rotational agriculture under natural rainfall conditions. The importance of this work demanded that the Department should give full and concentrated attention to it, and in 1950 we appointed a Research Officer solely for the purpose of investigating this problem. We have now four staff officers engaged on the problem of dry farming at Maha Illuppallama where we hope to have a first class research station where the problems of dry farming will be studied from all angles. To help us to solve this problem we asked the F.A.O. for the services of a Dry Farming Adviser and we were fortunate to have the services of Prof. E. A. Hardy for this purpose. He has been with us since 1951 and has helped us a great deal in our efforts to solve the numerous problems which dry farming entails. While we were engaged on this work with Professor Hardy, Mr. Karunaratne and Mr. Abeyratne laying down the foundations of research investigational policy, the New Zealand Government came to our aid by giving us a most generous grant of £ 250,000 or about Rs. 3 million towards the dry farming research scheme. That was in 1952. On this Dry Farming Research Station we are not going to concentrate our attention only on crops. We realize that no scheme of dry farming crop husbandry is going to be successful unless it is combined with animal husbandry. Therefore, in the Research Station at Maha Illuppallama we will study two aspects of this farming, the crop aspect on the one hand and the animal aspect on the other. When one of the representatives of the New Zealand Government came to Ceylon to see what was being done, he initiated the idea that animal husbandry research should play an important part in our scheme of dry farming. But we found that we would need more money to give full effect to this plan. The new proposal was put up to the New Zealand Government and I am in the happy position to tell you, that they have given us a further grant of £ 250,000 for the purpose. This means that the New Zealand Government has given us over Rs. 6,000,000 towards the initiation of work on dry farming research in all its aspects, including the animal husbandry aspect.

I would here, on behalf of the Board of Agriculture, express to the New Zealand Government our thanks for their most generous grant towards the solution of an extremely important problem in Ceylon's agriculture. We have about 3 million acres of highland which cannot be irrigated according to the Irrigation authorities, and these have to be utilized to best effect. The Rs. 6 million grant which the New Zealand Government has given us will serve as the foundation on which this great development will take place.

I have now presented to you a general survey of the position in regard to the problem of dry farming from the administrative point of view. I will now ask the two officers concerned to speak to you from the technical angle. I am sorry that Professor Hardy is not here today, otherwise he would have participated in the discussion and given us his views of the problem. I will not take any more of your time and will call on Mr. E. Abeyratne, Agricultural Research Officer at Maha Illuppallama to talk to you on dry farming from the investigational and research point of view ".

IV—A Talk on Dry Farming by Mr. E. Abeyratne, Agricultural Research Officer, Maha Illuppallama

" Mr. Chairman and Gentlemen—I propose very briefly here to discuss firstly the problems relating to the area under dry farming and then the problems of dry farming themselves. It is well established that very high and stable crop yields may be obtained under irrigation and where irrigation water is available, there is no better system possible in any country. However, there is a limit to the extension of irrigation set by the available water resources of any country and in Ceylon that limit is now being reached. When almost all the ancient irrigation schemes have been restored and with the completion of Gal Oya, Walawe Scheme and the Malwatte Scheme, there will hardly be any extension possible. The Land Utilization Committee has estimated that between two to two and a half million acres of unirrigable land in the dry zone will be completely out of reach of irrigation water and if we are to meet the increasing demand for food and satisfy the land hunger that now exists, it is absolutely essential that this dry land should be tackled somehow or other.

There are four ways of tackling this problem:

(1) By the cultivation of animal crops and encouraging animal husbandry;
(2) By establishing pure animal husbandry;
(3) By afforestation;
(4) By the cultivation of permanent fruit and economic crops.

At the moment the talk is food and more food and any system that will help us in achieving this situation is what should be aimed at. Dry farming can be defined as that system of farming which is possible in the absence of irrigation using rain water. The first question that comes into my mind is, where in the dry zone is this dry land available, how is it distributed and what are its present uses and what use can it be put to in order to meet our demand for food. Before any discussion on dry farming is undertaken it is necessary to review briefly the existing patterns of settlement and agriculture in the dry zone with a view to indicating where unirrigable land suitable for dry farming is distributed.

Characteristics of the Dry Zone

The Dry Zone comprises that region of Ceylon in which there is a prolonged dry season with a rainfall of less than twenty inches during the months April to September. During this period rivers go dry and water is scarce. In spite of an annual rainfall of 50 to 75 inches, therefore, water is the limiting factor to the extension of human settlement. The dry zone comprises 2/3rds of the Island and with Matale as the centre, can be roughly taken as the Northern Province, North-Central Province, part of North-Western Province, part of Uva, Eastern Province and Southern Province down to a little east of Tangalle. (Mr. Abeyratne indicated this area on the map.)

The contributory causes are:

(1) An unevenly distributed and often unreliable rainfall. (This was illustrated by a map.)

(2) Absence of extensive underground water supplies.

(3) Relatively shallow soils and sub soils with low water storage capacity.

(4) High temperatures and strong winds during the dry season with the resulting high rates of evaporation and transpiration. An evaporation rate of 1/3rd of an inch per day is the average for the dry season at Maha Illuppallama.

All these factors combine to make life in the dry zone absolutely impossible till about mid September. That is why the ancient people utilized all their energies on water conservation. The system of development adopted in the olden days is absolutely perfect in the line of water conservation and no further improvement on that system is possible. The system of village tanks and major irrigable schemes developed by the ancient people is too well known to need description." Mr. Abeyratne illustrated by means of a map a section of the Malwatu Valley to show the connection that that pattern of tank villages had with the extension and development of dry farming in Ceylon. Mr. Abeyratne continued "In order to meet the water supply for agriculture, there are two ways of doing it. First to conserve all the water that falls on land and divert the water from surplus areas into the dry zone. This system is somewhat similar to the ancient system of tanks.

The first method of total water conservation was developed to a high degree in the ancient days and the pattern of settlement based on tank villages will remain unchanged as long as no water is diverted from outside into any given region and no underground supplies of water sufficient for irrigation are available. In the second method, similar to the modern colonization schemes of Kagama, Minneriya, Parakrama Samudra and Gal Oya will result where nearly all the land is made irrigable.

From a point of view of dry farming, we have to start using each of these village units as a base. There is no alternative. The first step should be that the uncultivated land that is now in waste should be given a water supply and if we did that we will end with a system like the ancient system of irrigation villages. Dry farming development therefore becomes a scheme for the creation of new villages and the development of existing ones. From our dry farming point of view we start with the existing village units and from that view point it is necessary to study normally the structure of each of these villages, and roughly the problems of one village will apply to others as well. Similarly if we are to concentrate our attention on water conservation, the next problem that we have to tackle will be each river valley as a unit.

The dry zone consists of a large number of river valleys having similar climatic, topographic and agricultural conditions and with the exception of the Mahaweli, Walawe and Gal Oya, the rivers in all these valleys dry up during February to September. Underground water supplies are also very short and some provision for a continuous water supply is necessary if people are to live and grow crops in the area.

Most of the dry land in the dry zone is under forest but in the villages dry land is cropped under the traditional system of chena cultivation. The main problem of dry farming therefore is to place the chena on a more stable basis. From a point of view of long term fertility maintenance there is no better system than the chena but this practice has no survival value for economic reasons. Population pressure is increasing rapidly and it is not possible for any country to spare so much land for each family. In a chena cycle of cropping once in ten years, ten times more land would be required than if the land was cropped continuously. "

Pointing out to the map, Mr. Abeyratne said that on the other side of the Gangoda tank in which region the water table is high, chena cultivation was going on and the valley bottom was cultivated with paddy. Most of the irrigable low lands in that region were cultivated with paddy and the unirrigable land with chena and drought susceptible crops like coconut, and citrus where the water table was high. He added " We concentrated our attention on these highlands. Most of it is now under jungle and in villages under a system of chena. Our problem therefore is a very large one. It is one of replacing this chena with a more suitable system.

Problems of Dry Farming

Crops. A tradition for dry cropping therefore already exists and a start was made at the Experimental Station, Anuradhapura, in 1935, with growing the regular chena crops under a system of settled arable farming using crop rotations. It was found that good yields of cotton, chillies, maize, kurakkan, cowpea, green gram and black gram and more recently groundnut, dhal and sorghum could be obtained in an average year of rainfall. The results at Kurundankulama also indicated that this type of farming offered some prospects, provided a number of problems were solved. There was for example considerable difficulty in weed control, erosion was heavy and soil fertility tended to be rapidly lost but all in all, climatic conditions could be considered suitable for the production of dry crops. Other means of raising a living from dry land by animal husbandry by foresting and by the production of permanent fruit and tree crops need investigation. Emphasis at Maha Illuppallama is on the production of food crops and animal husbandry. From 1946 onwards, dry farming work was transferred to Maha Illuppallama and from 1950, it had got intensified.

When a chena cultivator abandons a piece of chena and moves on to another piece of jungle, he does it mainly because he finds it difficult to control the weed growth and rather than tackle the weeds in his chena, he prefers to open up a new block of jungle. We found that by clearing the land successively it was possible to control weeds for a year or two during which period we got good crops, but after that the cropping came to a standstill. The next point was that it was not possible to grow on every piece of highland the same crops.

Land Classification

At Maha Illuppallama and Kurundankulama it was experienced that all the dry land was not suitable for the production of cotton, chillies, sorghum, groundnut, maize, cowpea, &c. They tended to fail in certain areas and succeeded in others. At Maha Illuppallama we began to study this question of land classification. We came up against this problem, that since almost all the land in the dry zone were in small valleys and there was no flat land, there was a tendency for most of the dry crops to fail in the lower regions due to water logging and bad drainage.

At Maha Illuppallama perforated pipes were sunk to rock depth at sixty points over the Research Station and water-table heights were measured twice a week in each pipe using an electric probe. Location of the holes (' Water-table gauges ') in one of the catchment basins (basin C) on the station is given in figure 3 and the data on the mean monthly heights of the water-table in these pipes in table 1 and graphs 1 to 6. "
(This was explained and illustrated by Mr. Abeyratne by means of maps and charts.)

" It will be observed that there was no water-table at the water shed and upper slopes of the basin (gauges 14, 15, 18-21 and 24), while at the middle and lower slopes the water-table which was within six to eight feet of the surface during the rainy season fell sharply during the dry season. Gauges (13, 17). At the valley bottom the water-table remains more or less near the surface, falling more slowly during the dry season (gauges 11, 12, and 16). This year (1952/53), was a year of unusually low rainfall and by comparison the heights of the water-table recorded in pits in 1951/52, are also included in graphs 3 to 7. The water-table rose to within 3-4 feet from the surface at the water shed and upper slopes pit No. 5, graph 6, while on the slopes it was on the surface for short period and fell slowly, pit No. 1 and 4, graphs 3 and 5. At the valley bottom the water-table remained near the surface throughout the period during which the records were kept pit No. 2, graph 4.

Water-table behaviour is affected by rainfall as the figures above show. In 1952/53, only 15 inches were received from September to January, while in 1951/52, 47 inches were received. (Illustrated in table 1.) The fact that the overburden is only 15-40 feet thick would account for this rise in water-table during the rainy season. Table 1 includes the depth of rock below the surface in the bore holes in the catchment basin C. Elsewhere on the Station the rock lies at the depths of 15-40 feet and this is typical of a good part of the dry zone. Water-table behaviour is an important factor and has to be reckoned with in planning cropping systems in so far as its effect on drainage is concerned. With relation to water-table behaviour these three classes of land can be distinguished within each catchment basin.

(1) Land in which the water-table is not likely to influence cropping except in exceptionally wet years. Water shed and upper slopes.
(2) Land in which water-table rises to near the surface during the rains and falls rapidly during the dry season, lower slopes.
(3) Land in which the water-table remains near the surface for a greater part of the year—bottom lands.

The influence of irrigation tanks and channels has also to be taken into consideration. Generally the effect of a tank channel is to reduce the fluctuation in water-table level during the year in land in the vicinity of the tank. This introduces a fourth class in which the water-table remains stable, fluctuating only with the level of water in the tank.

If dry crops are to be grown on land on the type (2) and (3) drainage is a vital factor.

Experience with other areas has also shown that each catchment basin has a similar water-table pattern and from a point of view of drainage each basin has to be treated as a unit. Within each catchment basin there appear to be definite land classes related to water-table behaviour in which slightly different management problems are posed. Systems of land use suitable for each class of land have to be worked out ".

Mr. Abeyratne then explained the significance of soil colour and the close relationship that exists between soil colour and water-table behaviour by means of a map.

The following is an extract from his address:—

Soil Colour

" Figure 3 shows the soil colours in catchment basin C. Reference to table I and graphs 1 to 6 will show that a very close relationship exists between soil colour and water-table behaviour. Information collected so far points to the fact that textural and soil structure differences also occur between the land classes.

Detailed studies are in progress. Starting from the water shed of a catchment basin, profile studies down to the depth of a decomposing rock were made at points down the slope of the catchment in the representative land classes. A record of the detailed description of the soil horizons in these profiles was made, to be correlated with date from the chemical analysis of the soil and clay fractions from these horizons. The organic matter and Ph determinations, and the mechanical analysis of the soil from the respective horizons have been completed. The complete analysis of the soil S102, Fe203, AI203 TI02, P205, Ca0, Mg0, Mn0 and K2 are in progress.

Scheme of Land Classification

Four land classes have already been distinguished. It is considered necessary to separate the water shed from the upper slope as soil depth on the water shed is usually shallow and rock out drops occur very frequently.

In the dry zone most of the bottom-land is irrigable and a further distinction is made between irrigable and unirrigable bottom lands. Based on the factors considered above the following tentative scheme of classification has been drawn up to serve as a starting point in the study of land classes.

I. *Unirrigable Highlands*

(1) Watershed. Well drained, needs special erosion protection. Is best left under forest.
(2) Upper slopes. Relatively well drained, needs expensive soil conservation measures, disposal of storm water is necessary for raising dry crops during an average Maha, is best suited for dry crops.

II. *Unirrigable Lowlands*

(1) Lower slopes need drainage particularly in very wet years. Drainage is likely to be expensive. Disposal of storm water is necessary for cropping during the Maha. Appears to be more suitable for Yala cropping. Soil conservation measures similar to the upper slopes.

(2) Bottom lands. Needs expensive drainage systems if dry crops are to be grown. Land is flat and soil conservation measures need not be as elaborate as on the slopes.

(3) Lower slopes in the vicinity of tanks. Here the water-table is relatively high. A certain amount of drainage is needed. Suitable for drought susceptible tree and fruit crops.

III. *Irrigable Lowlands*

Land is generally flat and cultivated with paddy. No special soil conservation measures are required.

Maintenance of Soil Fertility

METEOROLOGICAL OBSERVATIONS

The mean daily evaporation from a free water surface, mean soil temperature at 4″ and 12″ depth under natural grass and the mean wind speed at twenty feet during the months March to September are shown in Table II ". (These tables were shown and explained.)

Mr. Abeyratne continued—" The next step was to suit crops into each of these classes of land. We are now trying to grow crops on the upper areas, fodder and vegetable in the middle slopes and paddy on the bottom lands. Taking the problem of cultivation itself, the rainfall during Maha is very intense. We get 35 inches of rain between October and January and these storms are very intense. We have recorded 1 inch of rain in 12 minutes and 4 to 5 inches in 24 hours. This means we have to grow crops spaced fairly close. Otherwise we expose the ground to tremendous erosion. There are two kinds of erosion. The first, resulting from rainfall which tears down a hill forming gullys. The second is the impact of the rain drops on the area year after year ultimately ending up with an area of loose sand and crops become almost impossible on such land.

To overcome this, a system of graded terraces is recommended. At Maha Illuppallama gully erosion has been controlled by a system of graded terraces discharging into a central storm drain located along the natural drainage line. By far the most serious source of erosion is the erosion caused by the impact of rain drops on a bare soil surface. Soil aggregates are broken up and the most valuable part of the soil, the clay, is carried away in the run-off water. At the same time we found that by any method of weed control we were intensifying the amount of splash erosion. So that, we had to solve these two problems of weed competition and prevention of erosion. For this purpose three experiments were started at Maha Illuppallama.

The first was where we grew between main crops a fast growing legume which covered the ground and checked weeds and there was weed control.

The second experiment was planting on ridges.

The third was growing cover crops at the tail-end of a season and allowing it to continue for the next season.

In the first experiment we found that the yield of chillies had declined by about 95 per cent. In the second set of experiments in the financial year 1950-51, we found that by growing on ridges, we got the biggest yield. In 1951 we had a rainfall of 27″ fairly well distributed. In the next year we had a rainfall of 47″, but the yield on the ridges had declined by 27 per cent. In the 3rd year we had only 15″ of rainfall and the yield on the ridges had again declined by 30 per cent. That was because when we cultivated ridges, the yield tended to fluctuate with rainfall. The third method of growing cover crops at the tail-end of a season was very promising and we got a yield of about 900 cwt. of cotton. Further there was absolutely no weeds and erosion was almost completely stopped. That line of work is being continued and we are growing Velvet bean during the tail-end of a season and allowing it to remain right through the year.

On the dry land there is an appreciable loss in soil fertility with continuous cultivation. Using green manures and legumes to maintain yields evidently is not very successful. At the moment there is very little information available as to how one can permanently maintain yields. For example if soil fertility is to be maintained as done in the chena system, one would need ten to fifteen times more land and it is not

possible to continue with this chena system for long. We are now investigating the possibility of resting the land for a short period under grass, secondly under small trees and thirdly under legumes. We are keeping a check on the effect of this form of soil structure and soil fertility and it is not possible at this stage to make any conclusive recommendations in that respect. We have found that a rotation with cotton in the first year, groundnut and gingelly in the Yala and sorghum in the 3rd year mixed with Tur Dhall is fairly satisfactory. Rotation trials designed to investigate the effect of different cropping sequences and duration of cropping and rest periods are also under study. There are some fertilizer trials also carried out and we hope that in about two to three years time we will have some information available.

On the question of designing of implements to suit local conditions, I must say that almost all implements imported from overseas are not entirely satisfactory for our purposes and Mr. Templeton is now working on the designing of these implements to suit our conditions.

We are introducing a large number of fodder experiments and food crops with a view to finding out something better than what we already have. At the moment we are concentrating on cash crops like cotton, chillies, Tur Dhall, cowpea and black gram. We hope that within the next two years we shall have something definite to report on.

In conclusion I would like to say that over 50 per cent. of the village tanks in the North-Central Province have a very precarious water supply. Paddy cultivation is liable to fail in many years. In Yala and in Maha, cultivation is very, very limited. The solution of this dry farming problem itself is a measure of relief and would contribute to the prosperity of these villages because at the moment their standard of living is very low and their living conditions dreadful. Conditions in most of these villages are deplorable and if dry farming can be taken up in these villages, there is a prospect that the standard of living will improve ".

V—A Talk on Dry Farming by Mr. C. R. Karunaratne, Agricultural Officer, Dry Farming

" Mr. Chairman and Gentlemen—The Agricultural Research Officer has given you an account of dry farming research activities ".

Mr. Karunaratne then read the following :—

Acreage of Ceylon. The total area of the Island is 16,200,000 acres ; of this only 3,500,000 acres are under cultivation with tea, rubber and coconuts, paddy and highland chena crops.

The remaining area of nearly 12,725,000 acres may roughly be grouped as follows :—

(*a*) Roads, streams, tanks, towns and villages	...	...	...	1,250,000 acres.
(*b*) Forests including National reserves and sanctuaries		...	...	3,500,000 ,,
(*c*) Rocky and steeplands and lands over 5,000 ft., &c.		...	...	4,750,000 ,,
(*d*) Balance available for future expansions	...	...	...	3,225,000 ,,

It will thus be observed that we have an extent of about 3,225,000 acres which is not being put to any productive use. Of the total area of 3,500,000 acres under cultivation, 2,800,000 acres are in the wet zone and only 700,000 acres are in the dry zone. In contrast to this most of the land available for further agricultural development are in the dry zone. Thus any further extensions of agricultural activities lies primarily in the dry zone.

The Dry Zone of Ceylon may loosely be defined as that part of the island where the annual rainfall is less than 75 inches per annum.

The Wet Zone is approximately bounded—

on the North—by the Deduru oya,
on the South—by the Walawe ganga,
on the West—by the Sea,
on the East—by the foot hill of the hill country.

Lands outside this area constitute the dry zone and forms about $\frac{3}{4}$ of the area of Ceylon (Northern Province, N.-C. P., part of N.-W. P., S. P., E. P., and low country of Uva). Most of the lands lie up to the 500 foot contour and consists of gently undulating land forming river catchments.

Climate and Rainfall of the Dry Zone

The total annual rainfall of the dry zone is less than 75 inches. Its distribution gives rise to two clearly marked seasons. About 75 per cent. of the rains fall in torrential showers during the months of October, November, December and January—during the Maha season, and about 20 to 25 per cent. during the months of April and May. Occasional scattered showers fall between February and March and June to September. Rainfall during the Maha season is always effective and storms of great intensity are frequent.

Dry South-Western winds blow across the area from June to September. Damages to unprotected crops and wind erosion are appreciable.

The character of the rainfall in the dry zone determines its pattern and system of agriculture and natural vegetations. There is rapid vegetative growth during the Maha rains from October to January. Lands cleared during the preceding dry season is covered with weeds, vegetation and secondary jungle. The main cultivation season takes place during this season.

Soils of the Dry Zone

These are shallow, compact, hard and relatively impervious. The soils are difficult to handle and become highly impermeable after rain and require very careful and skilful handling. The frequency of rains during the seeding season are such as to render intercultivation almost impossible due to the wet conditions with the result that weeds develop luxuriously.

There is a striking difference between the dry areas in India and in Ceylon. The rainfall in the dry areas in India ranges from 20 to 25 inches as compared to three times that quantity in Ceylon. But the Indian soils are deeper and more porous and water penetration is quicker ; the frequency of showers is such as to allow implemental cultivation and weeds do not present such a serious problem as in Ceylon.

Conservation of Water in the Dry Zone

We do not, unfortunately have any water bearing strata except in the north and parts of North-Western Province. During the dry season the underground water table lies at 30 to 40 feet below the surface of the ground. Most of the rivers and streams dry up. Life in the dry zone is impossible without storing and conserving water, particularly during the dry season.

The ancient people of the country realized the importance of stored water. Two systems were adopted by them for conserving the abundance of water dispersed over the plains during the rainy seasons.

One was to utilize and harness all the water that fell on a local catchment and effectively enbanking its outlets, thus giving rise to numerous village tanks.

The other was the more scientific and ambitious which was effected by constructing massive anicuts across rivers and turning the water through excavated channels. So careful were the people in utilizing these water resources on which their existence depended that even the surplus water from one tank which would spill when water was plentiful were not allowed to escape. The tanks were built in orderly method at slightly varying elevations, so that there often was a series of reservoirs to take the overflow of the one above it.

In this manner the face of the country came to be thickly dotted with these reservoirs. Paddy was cutivated in the irrigable areas and permanent crops were grown near the tanks. The surrounding unirrigable land was utilized for cultivating dry crops under rain fed conditions. This appears to have been the system of village settlement and the natural development of the dry zone. If water from outside can be used to augment supplies in smaller tanks or where no source of water is available, as it is over the greater part of the dry zone, then the existing pattern of tank village settlement must remain unchanged.

Chena Cultivation

When the ancient civilization broke down and the tanks went out of commission, the inhabitants of the dry zone were compelled to adopt the chena system of cultivation for lack of a better system.

The chena cultivator rotates the land instead of the crops. The advantages of this system to the dry zone villager are :—

(*a*) little equipment and no cattle are required ;
(*b*) accumulated fertility of number of years is utilized for the crops ;
(*c*) weeds are almost absent during the first year.

The success of chena system of agriculture depends entirely on the possibility of allowing the cleared forest to regenerate into its previous conditions before it is cleared again for a chena. As the population increases the chena cycle has necessarily to be reduced. This is already happening. It is not uncommon to see forests cleared at intervals of 3 to 5 years. The chena system becomes very destructive when a certain density of population is reached. Some authorities rate this density of population at 130 per square mile. The population density of the dry zone is about 120 per square mile. It is rapidly increasing and it would appear that we are approaching the danger point if we have not reached it already, considering the low rate of forest regeneration under our conditions of soil and climate.

The chief difficulties the dry zone villagers are confronted with to embark on an economic system of arable farming are :—

(*a*) age long custom ;
(*b*) lack of ownership of land ;
(*c*) ignorance of tillage operations, implements and animal husbandry ;
(*d*) inability to develop and render the land arable without financial assistance ;
(*e*) inability to purchase the necessary tools, equipment and draught bulls without assistance in the form of long-term loans.

There are at present in Ceylon about 200,000 of land in the dry zone which have been chenaed and cropped as chena. It is thus very clear that one of the most immediate and important problems facing the country is the replacement of the chena system by a stable system of rainfed cropping. It was in this perspective that Mr. Rodrigo, a former Director of Agriculture, envisaged the development of a stable rotational system of dry farming when he started the settlement scheme at Kurundankulama in 1938, and it is no exaggeration to state that this experiment is a land mark in the history of Ceylon Agriculture.

Dry farming implies the cultivation of arable crops without irrigation by utilizing the rainfall and moisture in the soil to the fullest advantage. The crops have to be cultivated according to the adaptability and suitability of the land, that is correct land use.

Kurundankulama Dry Farming Scheme

This was started by the Department of Agriculture in 1938 on an irrigable block of 100 acres at Kurundankulama, 4 miles east of Anuradhapura and the Trincomalee Road with the object of—

(*a*) Ascertaining whether the Wanni villager with guidance and assistance could be trained to take up to dry land arable farming on the land developed and rendered arable as a suitable substitute to his traditional chena cultivation.
(*b*) To ascertain the extent of unirrigable land an average peasant family could farm efficiently using simple bullock drawn implements and the income that could be obtained therefrom.
(*c*) Whether the fertility of the soil could be maintained under the prevailing conditions of intense rainfall during the comparative short rainy season, and long spells of drought and high temperatures.

Attempts to secure ten typical Wanni families proved futile owing to the natural conservation of the Wanni villager to abandon his home. Only one typical Wanni family was recruited. Nine other families made up the settlement of ten families in January, 1939. Some other selected families either abandoned their allotments or were weeded out for bad work.

The block of 100 acres was divided into 10 equal allotments one for each family, the first acre with the road frontage being used as the homestead. The development of the allotments was done in stages, beginning from January, 1938, and completed by 1943. It was the intention to clear and stump progressively each year an extent that each family could develop. A subsistence allowance of Rs. 15 per month was paid until the whole allotment was rendered arable.

Very soon the department realized that it was beyond the capacity of the settlers, while struggling for an existence, to develop their holdings expeditiously. The department thereupon developed and rendered the holdings arable at state expense, the settlers themselves receiving wages for the work done, thus supplementing their income when the production from partially developed holdings were insufficient for their needs.

Each family had a wattle and daub house and a latrine, a cattle shed and poultry run, on the homestead acre. This acre was planted up with citrus, mangoes, jak, breadfruit plants, &c., and interplanted with bananas. A small area was also set apart for vegetables. Eight wells were provided for the entire settlement.

The remaining 9 acres were cropped according to the following rotation :—

Block A—6 acres

1st year ... Maha—Chillies
Yala—Pulses
2nd year ... Maha—Cereals
Yala—Gingelly
3rd year ... Maha—Cotton
Yala—Cotton continued.

Block B—3 acres

1 acre—Bananas for five years
1 acre—Napier Grass for five years
These two crops to be rotated.

Block C—1 acre—permanent paddock. Each settler was given a pair of draught bulls, one cow, a pen of poultry and essential bullock drawn implements and tools. They worked their allotments individually while an Agricultural Instructor stationed at the scheme advised them. The development of all the 10 allotments were completed by 1943, each allotment costing Rs. 4,100.00.

In 1945 the department planned another dry farming scheme at Makalanagama in North-Western Province, about three miles from Galagamuwa on the Ehetuwewa road. This scheme was different to that of Kurundankulama in that the land was soil conserved on the catchment basis; farming on a co-operative basis was introduced and a part of the area was rested under a grass fallow instead of continuous cropping, thus weaving in live stock to the plan. This implied the use of the land alternatively for arable crops and raising live stock for a period of about 4 years and thereafter changing over.

The Kurundankulama experiment produced satisfactory results, and in 1947-1948 the settlement was extended by the addition of 84 acres to be farmed co-operatively by six families. The entire area was cleared and rendered arable, and permanent cottages constructed at state expenses. Each family was allotted 14 acres made up as follows:—

2 acres for the homestead to be worked individually;
6 acres for arable farming to be worked co-operatively for 4 years;
6 acres to be utilized for stocking for 4 years, thereafter to be ploughed up for arable crops.

The 84 acres block was divided into three, the middle block being used for the homestead and the front and rear blocks for cropping and stocking. They farmed 36 acres co-operatively and utilized 36 acres for stocking their animals. The settlers selected happened to be a heterogeneous crowd and by 1949 three were weeded out for bad behaviour and better type of peasants were recruited.

About this time, i.e., end of 1948 it was noticed that there was sense of frustration, discontent and dissatisfaction among some of the settlers of the original 10 families, whereas others appeared to be quite content and happy. Their grievances were looked into and were found to be genuine and justifiable. The system of farming had to be altered and improved.

The topography of the land these ten settlers farmed was fairly typical of the dry zone of the N. C. P. being slightly undulating with valleys in between. About 20 per cent. of the land was water-logged and ill drained. Arable crops could obviously not be grown in these water-logged areas. Thus the settlers who were unfortunate to cultivate these low-lying water-logged blocks were decidedly at a disadvantage. There were four such settlers and this group was naturally disgruntled and discontented when they looked around to see other members of their settlement who had allotments more favourably situated were reaping good crops. They also realized that the second group of settlers farming co-operatively were progressing and all of them raised good crops. The chief cause of the trouble was unequal distribution of suitable land for arable farming, and the necessity for soil conservation on a catchment basis.

In 1949-50 the old settlement was given an entirely new turn. The whole settlement was resoil conserved on the catchment bases with broad based graded bunds, all the run off from the catchment being harnessed in an abandoned tank which was restored. The low-lying areas were contour ridged with broad based bunds for paddy cultivation as a rainfed crop.

10 new permanent cottages were constructed in group form on a hillock, allowing 2 acres as homestead per settler to replace the wattle and daub cottages that were constructed in 1938. A new service road was constructed to serve the new group of cottages and the two groups of settlers. One irrigation well 38 feet deep and 30 feet in diameter was provided for the 10 settlers.

The next step was to even off the inequalities of the distribution of land for cultivation by converting the settlement into a co-operative farming unit. The settlers who were farming favourably situated fertile blocks simply jibbed at the idea and refused to agree, whereas the less fortunate ones welcomed it. By considerable persuasion coupled with sternness the 10 settlers eventually agreed to farm co-operatively commencing from 1950-51 season.

Their units of allotment and systems of cropping were changed. Each settler was given 2 acres homestead instead of one acre, and 12 acres for farming co-operatively on the alternate system of husbandry instead of 9 acres to be worked individually and cropping continuously. Old fences were removed and the entire block fenced separating the cultivated blocks from the resting blocks for cattle. The rotations were modified and crops were cultivated according to land capacity, i.e., correct land use, cropping along the contour interraces or bays was introduced. Low-lying areas were cultivated with paddy as a rainfed crop.

The Rotation now being practised is—

1st year	...	Maha—Cereals—Sorghum, Kurakkan mixture and Dhall
		Yala—Sorghum ratooned—Gingelly
2nd year	...	Maha—Chillies
		Yala—Chillies
3rd year	...	Maha—Cotton
4th year	...	Maha—Pulse mixture with Dhall spaced widely
		Yala—Gingelly.

The broad based bunds to be planted with Tur 5 dhall. To enhance their incomes the settlers can cultivate vegetables during the Yala season by lift irrigation during favourable seasons.

Thus two groups of settlers commenced farming co-operatively, one group of 6 settlers and the other 10. Each group selected its own leader or gamarala. The selection of the leader is done annually before the commencement of the Maha cultivation season. The leader of each group or unit takes instructions and follows their leader in all the co-operative farming operations. The leader acts under the guidance and directions of the Agricultural Instructor-in-charge of the settlement.

The 10 settlers that embarked on the new venture of co-operative farming after about 10 years of farming their allotments individually happened to be a heterogeneous crowd and they found difficulty in pulling together. At the end of the season of their own accord they requested that their group be split into two units of five each. Their request was granted and the land was blocked out accordingly.

A co-operative store established on the farm was revived and reorganized. All the settlers obtain their provisions from this store.

The total produce harvested by each co-operative unit is divided between the settlers according to the labour units contributed by each family. One labour unit is earned by one man working one day. Three-quarter labour unit is earned by a woman, or by a boy or girl between 14-16 years working a day, and half a labour unit by a child between 14 and 16 years working a day. The leader maintains a record of labour units for each family of the unit.

Extension of Dry Farming Schemes—Kurundankulama and Relapanawa encouraged with the result of the Pilot Settlement Scheme of Kurundankulama

In 1950, the Ministry decided to open two dry farming schemes to settle 40 families at each. Two sites were selected in consultation with the Revenue Officers. One site was at Kurundankulama, the extension covering an area adjoining the already established dry farming scheme. The advantage of this area was

that a very large extent of land was available in the triangle formed by the Anuradhapura-Trincomalie Road, Anuradhapura-Kandy and Mihintale roads. It had the added advantage that it was four miles from Anuradhapura.

The second site selected was close to Relapanawa village, 13 miles from Anuradhapura on the Anuradhapura-Puttalam road.

Development of the land

The clearing of jungle, stumping, rooting and cross-rooting, levelling anthills, construction of roads and restoration of abandoned tanks at Kurundankulama were done by the Land Development Department with machinery—D8 tractors, with bulldozers and rooters, while at Relapanawa these operations were done by the Agricultural Labour Corps with machinery and with labour. As the Agricultural Officer was in charge of the two schemes, all these operations were done under his supervision. All the colonists' cottages, latrines, wells and the general buildings such as the school, School Masters' quarters, Manager's and Conductors' quarters, meeting hall, co-operative stores and dispensary were constructed by the Land Development Department.

The entire planning and lay out of the whole scheme, siting and demarcating wind belts, siting of tanks, ponds and groups of cottages and general buildings, tracing of the network of roads, soil conservation on the catchment basis, fencing, &c., at both the schemes were done by the Agricultural Department under the directions of the Agricultural Officer and his field staff.

Provision of Wind Belts and Fuel reserves

Belts of forest, 300 feet to 500 feet wide spaced every 2,000 feet to 3,500 feet apart were left along the ridges to serve as wind breaks and as fuel reserves. The space between any two wind belts depends on the topography of the land. The undergrowth of these wind belts have to be cleared leaving intact all valuable timber trees and other trees with good spreading crowns. Uneconomic and useless trees such as Veera can be exploited for firewood and the gaps planted up with useful trees such as Halmilla, Teak, Mango and Cashew. A large number of Halmilla seedlings have been planted in the wind belt and along the fences at Kurundankulama and at Relapanawa. Of about 10 per cent. have survived at Kurundankulama and about 5 per cent. at Relapanawa. It is proposed to plant an appreciable number of Teak and Cashew seedlings with the Maha rains in 1953.

Restoration of abandoned Tanks

Several abandoned and breached tank bunds in varying stages of disrepair were found in almost every catchment at both the centres, seven at Kurundankulama and six at Relapanawa after the land was cleared and the jungle burnt. All the thirteen farm tanks were restored by filling the breaches and widening and raising the bunds by heaping the soil excavated from the beds in the process of deepening. This was done with heavy earth-moving machinery. In addition to these an abandoned pond measuring about 100 feet in diameter was restored at Relapanawa.

Soil and Water Conservation

The cleared area was soil conserved on the catchment basis with broad based graded bunds. Fields in the valleys that get water-logged during heavy rains were soil conserved with broad based contour bunds for cultivation of paddy as a rain fed crop during the Maha season. The storm water drains leading from the ridges were diverted to the tanks. All the run-off water from each catchment was harnessed and stored in the tanks. The aim was not to allow any run-off from the area cleared to find its way outside before being harnessed and stored in the various tanks situated in the different catchments within the scheme. The water stored in these tanks apart from the beneficial effects of gradual raising of the water table, would be very useful for domestic and stock purposes, and for cultivation of vegetables, etc., during the yala season.

Lay-out

The 80 homesteads of 2 acres each—40 at Kurundankulama and Relapanawa respectively have been grouped in units ranging from 4 to 9 houses, each unit being provided with a common well 15 feet in diameter and 30 feet deep. All the homestead units have been located on the upper reaches of the farm tanks.

Barbed wire fences have been erected round the perimeter of the homestead units and round the blocks to be cultivated co-operatively by the colonists. The blocks to be cultivated co-operatively are divided into two sections, one section for the cultivation of crops and the other for resting and stocking (pasture for cattle). The blocks carrying crops of paddy are also perimeter fenced. Kapok, Halmilla, Mangoes and ornamental avenue plants have been planted along the fences to serve as replacements for fence posts later on, but owing to the severe drought experienced this year the strike has been poor.

Buildings

Each allottee is provided with a type plan cottage, a latrine and a temporary cattle shed. One temporary shed is also provided for each unit to serve as a store to keep carts and implements and also to store the produce of their co-operative blocks as these are harvested.

It was very unfortunate that the roof work of all the cottages have been constructed out of ordinary jungle round timber instead of using sawn timber. This was presumably due to the temporary shortage of sawn timber at the time of constructing these buildings. The roofs are thatched with cadjans. It is however gratifying to record that the defect has now been rectified by tiling these cottages.

Amenities

A separate block of about 10 acres has been reserved at each centre for a school for the allottees' children, quarters for the school master, co-operative stores, dispensary and a meeting hall. All these buildings have now been completed and are functioning. The co-operative stores are functioning at both the centres.

Quarters are also provided for an Agricultural Instructor and for a conductor and an office cum circuit bungalow at each scheme.

Acreage and Make up of each Scheme

	Kurundankulama (extension) *Acres*	*Relapanawa* *Acres*
Gross acreage opened up	1,068 ..	677
Number of farm tanks restored	6 ..	6
Allowance for tanks at full supply level	34 ..	40
Wind belts	225 ..	60
Roads and drains	12 ..	5
General buildings and quarters for officers	12 ..	12
Acreage actually cultivated..	448 ..	320
Acreage rested for stocking..	336 ..	240
	1,068 ..	677

Selection of Allottees

It was decided to give preference and priority in the selection of allottees (to these two schemes) to landless married men who had undergone training at the various practical Farm Schools maintained by the Department of Agriculture. A special Land Kachcheri notice was drawn up for the dry farming schemes by the Land Commissioner in consultation with the Agricultural Officer, Dry Farming, a copy of which is attached.

Land Kachcheries were held at Colombo, Galle, Matara, Kegalla, Kurunegala, and Anuradhapura. The response was very disappointing as most of the married candidates that were eligible for application were already employed as Food Production Overseers, Demonstrators, Administrative Secretaries of Co-operative Agricultural Production and Sales Societies. With a view to giving those still unemployed a further chance,

the marriage qualification was not enforced and fresh land Kachcheries were held when 39 passed out students were selected from various parts of the Island. Twenty-three allottees for the remaining 4 allotments were selected from landless peasants, priority being given to those residing in the North-Central Province.

Some of the cottages were not ready for occupation until the end of November, 1951.

At the end of December, 1951, sixty-two allottees had been selected and were residing in the allotments as detailed below :—

District	*At Kurundan-kulama*	*Relapanawa*	*Total*
Passed out students from Kegalla District ..	16	9	25
Passed out students from Kurunegala District	4	1	5
Passed out students from Kandy District ..	1	—	1
Passed out students from Kalutara District	2	—	2
Passed out students from Colombo District	1	1	2
Passed out students from Matara District ..	4	—	4
Peasants from N. C. P.	—	23	23
	28	34	62
Vacancies to be filled by peasants ..	12	6	18
	40	40	80

Out of the 39 passed out students selected 32 were bachelors and 7 were married. The bachelors arrived with a helper or two as instructed to, but in most of the cases the helpers left them after a short time leaving the bachelor allottees to carry on single handed. This work as such was by no means an easy task with the result that they endeavoured to attend to the homesteads and neglected the Co-operative Units.

Strenuous efforts were made by the visiting and resident officers at persuading these " students " allottees to settle down to work. Their helpers would perhaps have not left them had these care-free bachelor " students " allottees refrained from adopting a superintending attitude. When the helpers left, these allottees expected the crop of certain units sown for their use as they were late to take up residence, to be also gathered and delivered to them at Government expense. Even the valuable grafted and other plants supplied free for planting in their homesteads were neglected. A scrutiny of the records of yields and the income derived from the sale of crops is glaring evidence against the degree of their efforts in comparison with the sober allottee who had crying mouths to feed. Twenty-two student allottees unfitted for this type of work left the allotments before they were expelled, and all the vacancies were filled by landless peasants from the North-Central Province and from Matale North.

By the end of August, 1952, all the allotments were occupied and the set up was as follows:—

	Kurundan-kulama	*Relapanawa*
Passed out students—Married ..	6	1
Passed out students—Bachelors ..	7	3
Landless peasants ..	43	36
Total ..	56	40

Scheme of Work

Each allottee is given 14 acres of land of which 2 acres are for his homestead to be worked by him and his family individually. The remaining 12 acres form part of the undivided portion of the land, held in common by the unit or group, to be farmed co-operatively by all the members of that unit. Out of the land held in common by the unit for co-operative farming, half of the extent would be farmed co-operatively by all the members of that unit and the remaining half would be rested as grazing ground for all the cattle belonging to the members of that unit. For example, if a unit is composed of 6 families, the total extent of land allotted to them would be 84 acres. Of this, 12 acres would be utilized for the homesteads at the rate of two acres per family. The remaining 72 acres would be farmed co-operatively by the six families, 36 acres being cropped for four years and the remaining 36 acres being rested as grazing ground for their cattle. After four years there would be a change over, the ploughed or cropped area would be rested and the rested area cropped.

The allottee's cottage lavatory, cattle shed, poultry house, compost pits, &c., are situated on the homestead. The block is utilized as follows:—½ acre under Java kapok, ¼ acre under banana, and ¼ acre under vegetables. Bananas and vegetables are to be rotated once in four years. The remaining area is planted up with fruit trees and intercropped until the fruit trees develop. The boundaries of each homestead are separated by live fences of Murunga and Katurumurunga plants.

Each allottee works his homestead on an individual basis and is personally entitled to the produce of his labour. He can dispose of his produce according to his own wishes if he so desires. This system has the advantage of combining the co-operative and individualistic elements.

Each unit elects its own leader or gamarala once a year before the commencement of the Maha cultivation season. The leader guides the members of his unit, maintains check lists of labour and records of produce harvested, and settles as far as possible petty quarrels and disputes among the members of his unit. He represents his unit as a member of the working committee of the society. He is advised and guided by the resident Agricultural Instructor who is the Manager of the Scheme. He is paid a bonus of 1 per cent. from the gross income of each member of the particular unit for services rendered.

Two co-operative societies were formed, one at each centre in 1952. These were not registered until all the allotments were occupied and the population became static after the departure and expulsion of those who were ill-fitted to the tasks. In September, 1952, the two societies were registered as (1) Kurundankulama Dry Farming and Sales Society, Ltd., (2) Relapanawa Dry Farming and Sales Society, Ltd.

The resident Agricultural Instructor who is the Manager of the Scheme functions as President and Treasurer of the Co-operative and Sales Society at each centre. Each Co-operative Society maintains a provision store for the benefit of its members who are given credit facilities up to a fixed limit. This has prevented them from falling into the clutches of the local traders.

These are two unique societies, the only two of its kind in Ceylon.

Every allottee is a member of the Co-operative Society. Every member has to cultivate the allotments in accordance with the planned programme and rotation laid down by the Dry Farming authorities. They have to conform strictly to all the regulations laid down by the Land Commissioner in allotting land to them. Any livestock issued by Government to the Society is in turn loaned by the Society to its members. No member is allowed to maintain more than 6 head of cattle, 8 goats and a flock of poultry. All progeny raised from such foundation stock will be the property of the member who raised such progeny. All the produce from the Co-operative units and preferably from the individual homestead allotments as well are to be disposed of through the Society.

It is the duty of every group of members of a unit to maintain in proper order and in good condition all roads, drains, avenues, fences, pasture blocks, wind belts, farm tanks and ponds. Whenever the members have failed to attend to these, the Society will, after due warning, execute this work by engaging outside labour. Such expenditure will be deducted from the particular group.

If through the negligence of the members any damage is caused by fire or cattle to crops, buildings, fences, etc., such members will be liable to pay as decided upon by the committee the cost of the damage to the particular unit or the individual member concerned.

The Society maintains and controls all issues made by Government such as draught bulls, cows and other livestock, carts, seed drills, intercultivator ploughs, disc harrows, etc. These are in turn loaned or issued by the Society to each unit or member for specified periods of work, in some cases on hire, as may be decided by the working committee.

Each member has to maintain in good order his cottage and lavatory and his cattle shed. Where a member fails to do this, the necessary repairs will be effected by the Society and the cost charged to his individual account. All the general buildings will eventually be maintained in good condition by the Society.

No member is expected to be away from his allotment at any time without informing the leader. Before leaving his homestead he has to make adequate arrangements with the leader for the proper care and maintenance of his livestock and house. The leader in turn informs the President. The leader cannot absent himself without informing the President.

The standard of cultivation will be done to the satisfaction of the dry farming authorities. Any allottee or group of allottees that fail to maintain a good standard of cultivation or are found to be indifferent farmers or violates or attempts to violate any of the conditions of the permit or any instructions given by

the Dry Farming Authorities will have the permit cancelled and the allottees will be compelled to quit their allotments and leave the settlement altogether. No such allottee will have the right to claim any compensation from State on any grounds whatsoever.

Every member has to pay a land tax at the rate of Rs. 10 per acre per annum for every acre under cultivation. This will be Rs. 80 per annum.

The work of the farm is normally performed by the members of the Society while assistance is only resorted to when it is necessary to call in hired labour to supplement the full labour strength of the Society during rush work.

The President maintains a check roll showing the labour turn out of every member. At the end of the season a complete statement showing the labour days earned by each member is exposed for two weeks at the President's office before the day of the general meeting at which the distribution of the income of the farm is to be decided.

The division of the divisible income is done strictly pro rata according to the labour units earned. In reckoning labour units, a man is reckoned as 1 unit; a woman $\frac{3}{4}$ unit; a boy or girl between 16 and 18 years as $\frac{3}{4}$ unit; children between 14-16 years as $\frac{1}{2}$ unit. All the harvested produce from each co-operative unit are handed over to the Society stores. These are valued and the price to be paid per labour unit is arrived at. Each member is then paid after making the following deductions:—

(*a*) Land tax and seed reservation for the following year;
(*b*) Payment of any cash loans, seed loans, work hired out by implements and machinery and for any other work done by the Society on behalf of the member; foodstuffs supplied on credit by the co-operative stores;
(*c*) Payment of 1 per cent. of the gross income as bonus to the leader of the unit for services rendered:
(*d*) A deduction of 2 per cent. of the gross income for a Reserve Fund. The cash will be deposited in the Co-operative Bank. This reserve fund will be for assurance against crop failures, etc. This reserve fund is indivisible.

The success of the co-operative schemes of this type depends largely on the selection of the correct type of settlers. Progress at the two major dry farming schemes at Kurundankulama and Relapanawa suffered very appreciably during the first year as a result of recruiting unmarried passed out farm school students most of whom were ill-fitted for this type of work. The officers managing these schemes should essentially be very human minded, patient and tolerant, mix with settlers freely, listen to their woes and complaints patiently and at the same time be firm. The measure of success achieved so far is largely due to the officers managing these schemes possessing these qualities. They, as pioneers, have had an uphill task which they have discharged so far admirably well.

Most of the old settlers plough and prepare the land for seeding with bullock drawn ploughs as their bulls are well trained and the settlers have the necessary experience. The newcomers, however, were unable to prepare the land in time owing to their inexperience and the plough animals being not sufficiently well trained with the result that the land was tractor ploughed for them on payment at the rate of Rs. 24 per acre for ploughing and harrowing. With the formation and registration of the two Co-operative Societies and discussions at the general meetings and meetings of the managing committee, the outlook of the settlers has changed. They now feel that they have a deep sense of responsibility and that the Society is responsible for their well being and advancement. They have realized the importance of timeliness in preparatory cultivation of arable crops in the dry zone. Two Fordson tractors with ancillary equipment, one for each Scheme, were made available by the Director of Food Production in February, 1953. The managing committee controls the programme for working the tractor on hire. Each unit submits a requisition to the committee outlining the works to be done on hire for their units. After completing the work in the settlement the committee hopes to undertake ploughing of lands on hire within a radius of about five miles round the settlement. They have on their own initiative decided and agreed to pay the leader a bonus of one per cent. from their gross income for services rendered. They have also decided to hire out the bullock drawn disc harrows to the members of the settlement at the rate of twenty cents per day.

One difficulty that was experienced at the early stages in working the co-operative unit was in respect of the output of work by each member. The more efficient and hardworking felt that the others could not keep pace and wasted their time to cover up the number of hours. They readily agreed to a system of

payment according to the quantity and quality of the work done. The Managing Committee will draw up a work day task standard or quotas of work of operations on the settlement to be done by men, women and children. A work day will be credited to the farmer only if he fulfils the set quota in its entirety. If he does not complete the quota he will get less credit, while on the other hand if he does more than the quota he will receive more credit proportionately. The quality of the work will be considered as well as the quantity.

The system of payment for labour in accordance with quality and quantity will give every member, a direct material interest in the results of his work, and will be one of the best means of encouraging a high level and improvement of labour productivity in co-operative dry farming schemes. The system will be started from Maha season 1953-54 onwards.

Development of Dry Farming Schemes in Villages in the Dry Zone

Apart from establishment of Dry Farming Colonization Schemes the question of extension of these schemes to existing villages deserves full consideration. Here it will be a problem of expanding and converting an existing established village into a planned system of agriculture.

A village or hamlet in the North-Central Province and possibly in other parts of the dry zone too can be considered as a cluster of ill-ventilated huts, with hardly any compounds for cultivation, and generally situated below the bund of the village tanks. During the rainy season the village becomes a quagmire due to the seepage from the tank and also due to the low-lying situation of the village.

They cultivate a portion of their paddy fields each season, the exact acreage to be cultivated depending upon the quantity of water stored up in the village tank. For their highland crops they chena Crown land often far away from their homesteads and thus eke out a precarious existence. Their cattle are allowed to roam about, invariably damaging other cultivations.

Land is not essentially the limiting factor for development of village agriculture in the dry zone, but it is water. The stored water in the village tank can be considered as the very life blood of the village community, without which life would not be possible.

Therefore the most important work to be undertaken should obviously be to harness every drop of water and to store it in the village tank by:

(*a*) Raising the bund where necessary;
(*b*) Diverting streams where available into the tank;
(*c*) Repairing the structures, spills and sluices, etc., and if possible deepening these tanks. Deepening is suggested not for irrigation but utilizing the water for domestic and stock purposes.

The next consideration may be planning of the village allowing one to two acres per family for the homesteads and providing the necessary amenities. The houses constructed according to a type plan to suit the district, may be located on the upper reaches of the tank.

The next stage would be the introduction of dry farming methods in place of the existing system of wasteful chena cultivation. The development of the land for dry farming will be on the same general principals as recommended for the present colonisation schemes. The land to be selected for this should be immediately around the homesteads, on the upper reaches of the tank.

In view of the fact that the villagers would be cultivating their own paddy fields, the unit of land for dry farming may be smaller, say a minimum of seven acres including one acre for homestead (as against 12 acres excluding the two acre homesteads for the dry farming colonists).

The 7 acres may be utilised as follows:—1 acre for homestead and 6 acres for cultivation of which 3 acres will be cultivated for 4 years and the balance 3 acres rested for stocking for 4 years and thereafter changing over. The system of providing for stocking is very important to prevent the cattle from straying about and thriving at the expense of cultivations belonging to others.

Well planned Dry Farming Units may be established in villages. Schemes of paddy cultivation cum dry farming in units of individual villages, as envisaged, worked as far as possible on co-operative lines under sound directions, would stop wasteful destruction of forests, increase the standard of living of the villagers, step up production and improve their livestock by a process of grading up. Thus each village can be considered as a self contained unit. Such a scheme will maintain a natural balance of cultivated land and forests.

This system of planned and settled agriculture can be established in the numerous new village expansion schemes started a couple of years ago particularly in the North-Central Province and more recently in Matale North, to start with.

The villagers will fell, clear and burn the jungle without assistance. In view of the fact that Crown lands are to be developed, full cost of stumping, soil conservation on the catchment basis, sinking of wells, levelling anthills, construction of tanks and ponds and laying out of roads may be borne by the State as this would by an investment by the State in the development of land belonging to the State and in the well being of an agricultural community which would be the backbone of the country.

Expenditure to be incurred for construction of houses, fencing, purchase of implements and equipment, live-stock, cultivation loans, etc., may be on long term loans from C. A. P. & S. Societies.

Dry Farming Scheme—Olukaranda

This dry farming scheme is situated three miles from Kekirawa—near the 61st mile on the Kekirawa-Anuradhapura road. The land selected happened to be an abandoned village named Rattagala Halmillewa, adjoining Olukaranda village in Kalagampalata of Nuwara Kalavia in North-Central Province.

A part of this land had been used as a military camp during the last world war. The attraction for this site apart from its favourable situation was the presence of two big irrigation wells with unlimited supply of water, constructed by military authorities. These two wells supplied water to military camps at Habarana and Sigiriya, about twenty miles away.

Clearing operations commenced on the 18th of May, 1950, and approximately 100 acres were cleared, stumped, soil conserved on the catchment basis with broad based bunds fenced and an abandoned village tank restored. Five cottages were constructed and a well for domestic purposes built. Three landless families from Ihalagama village in N.-C. P. and two from Central Province who had migrated into N.-C. P. were settled. The five families formed a population of 44. The same extents and system of co-operative farming as at the other two major schemes were adopted at this centre.

In 1952 two more families were settled thus bringing the total to 7. A co-operative credit society was registered in 1952 to provide credit facilities to the settlers in the form of cultivation loans, etc., and thus free them from the grips of local traders.

The tank that was restored earlier was deepened and the bund strengthened in 1952. An extent of about three acres below the tank was levelled and ridged for paddy. Besides these an extent of about 8 acres of low-lying land in the valley was levelled for paddy as a rain-fed crop during the Maha season and for raising vegetables, etc., during the Yala season with lift irrigation from the irrigation wells. A centrifugal pump driven by an engine will be installed for this purpose.

The incomes obtained by these settlers since they commenced farming are tabulated below:

Year	*No. 1*	*No. 2*	*No. 3*	*No. 4*	*No. 5*
1950-51 ..	1,375·78	1,388·14	1,337·02	1,424·01	1,216·73
1951-52 ..	1,246·28	1,589·22	1,348·43	1,459·01	1,078·44

Settlers Nos. 1 and 3 had mortgaged their paddy fields for Rs. 250 and Rs. 150 respectively before they joined the scheme. Both of them redeemed their mortgages from the income obtained at the end of the first year.

Settlers No. 2 purchased a small plot of land at Olukaranda for Rs. 150 and also purchased a push cycle for Rs. 200 for his son to attend school, from the income obtained at the end of the 2nd year.

Settler No. 5 purchased a push cycle for his son to attend school from the income obtained at the end of the 2nd year.

Dry Farming Scheme—Makalanagama

This scheme is situated 2½ miles from Galgamuwa on Ehetuwewa Road in Wanni Hatpattu in the North-Western Province.

The extent of about 300 acres was cleared in 1944 when the writer was functioning as Agricultural Officer, North-Western Province. The entire area was rendered arable, stumped, soil conserved with graded bunds on the catchment basis and the acreage between each bay surveyed and computed. Five abandoned tanks within the cleared area were to be restored.

In 1945 a dry farming scheme was started to test the possibilities of Co-operative farming on the alternative suggestion of husbandry by settling villagers from already established villages in the district without recruiting colonists from other districts.

The system of co-operative farming was later adopted at Kurundankulama in 1948.

The land was divided into two units with 7 homesteads on each. The writer left the Division when the cottages were being constructed and before the scheme started functioning. With the formation of the Dry Farming Division this scheme was handed to the writer in July, 1952.

Chairman: " Gentlemen, you have heard two papers on Dry Farming one from Mr. Abeyratne on the fundamental problems relating to a successful system of dry farming and the investigations that have been carried out towards the solution of some of them. The other was Mr. Karunaratne has told you something about the practical application of this scheme in areas which are thought ideally suited for this type of agriculture. Now we will be happy to have from members their points of view on the subject and any questions they would like to ask."

Mr. N. H. Keerthiratne, M. P. and Parliamentary Secretary, Ministry of Posts and Information inquired whether records of trials carried out after the Maha Illuppallama Research Station was opened in 1903 was available and whether the speakers could enlighten the Board as to why it was considered necessary to close down that station in 1919. He added that his viewpoint was that instead of starting trials all over again, it would have been better to start where trials and investigations had stopped on the earlier occasion.

Mr. Keerthiratne also stated that he would like to know what permanent crops were recommended in those dry farming villages as a result of investigations carried out; what the average income of a Vanni village family was and the breed of the two bulls and the cow allotted to a village family and whether they were imported animals acclimatized to the Vanni conditions.

Mr. Keerthiratne also inquired whether all the trees were uprooted when the land was cleared for cultivation, because in the villager's method of clearing land, he did not uproot all the trees.

Chairman: " In regard to the question of the Maha Illuppallama Research Station which was opened in 1903, we do not have full details of the records of trials carried out at that time but we have annual reports of the Department covering that period. We know from their findings that cotton was tried out on this Station and did fairly well in some seasons but not in others. We have there a coconut plantation which was started in 1903 and is producing fairly satisfactorily. We have records that sisel hemp was started on this station, but it is not possible to make a success of the crop unless it is cultivated on a very large scale. Therefore we should not judge experimental work carried out 50 years ago in the light of our experience today. A number of experiments have been carried out and we are trying to get more detailed information from them."

Mr. Keerthiratne: " I would kindly ask you, Sir, that in future records of all experiments be preserved in a library or some such place for future reference. "

Chairman: " I can assure you that at the present time full records of all our experiments are kept and are available for reference. "

Mr. Abeyratne: " As regards records I can say that full detailed records are maintained for all our experiments and these records are not only maintained for reference but results of certain experiments are published.

In regard to permanent crops, the position is that if there is no water stored artificially, there is no water in the sub-soil. If you do not store water in the sub-soil for a number of years and if the water on the surface is allowed to drain off, it is not possible to build up a water table and it is not possible to grow any kind of dry arable crops like coconut, plantain, papaw, etc. The ancient people realised this and that is why they built several tanks for storing the surface water and also a series of reservoirs were constructed at lower elevations to take the overflow of the ones above them. Mr. Abeyratne explained further by reference to the several maps which were got up by him for the purpose.

Mr. Ashmore Pieris inquired how much of land was allotted for the homestead and what acreage was utilised for arable crops and also what was cultivated in the homestead area?

Mr. Karunaratne replied that at Kurundankulama, land was allotted to each villager as follows:—

2 acres for the homestead to be worked individually,

2 acres for arable farming to be worked co-operatively for 4 years,

6 acres to be utilised co-operatively for stocking for 4 years, thereafter to be ploughed up for arable crops.

He added that bananas, napier grass, chillies, cotton, gingelly, sorghum, ground nuts, kurakkan, dhall, etc., were cultivated and permanent trees like halmilla, kapok, teak, etc., were grown along the fences. The two-acre homestead area was planted up as follows:—

½ acre under kapok,

¼ acre under vegetables,

¼ acre under bananas.

Bananas and vegetables were rotated once in three or four years. The remaining area was planted up with fruit trees and other permanent trees.

In reply to Mr. Keerthiratne, Mr. Karunaratne said that sixteen allottees were given Scindi cows and twelve allottees were given black Sinhala cows and that they would be crossed with Tharparkar bulls.

Referring to a question by Mr. Keerthiratne about the uprooting of trees when a holding is cleared for cultivation, Mr. Karunaratne said that usually three to four trees were left behind in each acre cleared.

Mr. Keerthiratne inquired whether the Department had endeavoured to give the youngsters (children of the colonists) in these dry farming villages a training in the different methods of cultivation, use of new implements, etc.

Mr. Karunaratne replied: "We have not come to the stage when the children of these colonists are sufficiently big enough or old enough to be able to give them a training in agricultural practices."

In answer to a further question by Mr. Keerthiratne, Mr. Karunaratne said that the average income of a colonist worked out to about Rs. 2,000 a year, exclusive of all vegetables and produce consumed by them.

Mr. Ashmore Pieris: "I suppose you grow citrus on the highlands in these areas?"

Mr. Karunaratne: "Citrus has not done very well in that area. I think about 60 per cent. of the trees die during the severe drought.

Mr. Ashmore Pieris: "In areas like Bibile and Moneragala citrus does well and that is also a dry zone area, and these areas are even considered feasible for poultry. How could you explain why citrus does not do well in the dry farming villages?"

Mr. Karunaratne: "I quite appreciate Mr. Pieris' point of view. Bibile is essentially a citrus growing area where the soil is deeper and there is a better rainfall more evenly distributed. Mango has instead proved to be very successful in the dry zone and we have encouraged poultry in these mango orchards, but unfortunately due to religious prejudices, all are not keen on poultry farming."

Mr. Ashmore Pieris: "Could I know your experience in Yala cultivation in these areas? I think Dr. Rhind sometime ago told me about his experience, and not to grow anything in the Yala season and that it would be better to rest that land entirely in Yala and grow during Maha."

Mr. Karunaratne: "Yala cultivation in the dry zone is really a gamble. We grow gingelly, tur dhal and sun hemp during the Yala season."

Mr. Marcus Rockwood: "I am inclined to think that there are too many experts. We cannot get away from the fact that dry farming as practised in countries like the U.S.A., parts of South Africa and Australia cannot be adopted here. I consider that the water requirement, whatever the crop may be, under methods of dry farming, should be more or less the same as that required for the same crop in wet areas. Hence I consider that the essential conditions to make a success of dry zone cultivation are a good subsoil, abundant supplies of water within a reasonable distance from the surface, temperature

of such a nature that would not scorch the earth during the greater part of the year, and an absence of winds which not only dry up the little moisture in the soils but also carry away during certain seasons fine particles of good earth.

There was no doubt that the dry zone should come under the plough to meet the demands for food by our increasing population, but other methods have to be found. It is not that such methods were unknown to the cultivator. These same tracts were cultivated successfully a few hundred years ago. Now under the guise of dry farming, experts, I believe, are recommending the successful methods of long ago under the kings of old.

What we now want is not experts, but the will to make every tank, irrespective of size, to function up to 100 per cent. efficiency. Then our dry zone will flourish and produce the goods. We have our own men, give them all the assistance, for they know more of the subject than any foreigner can teach them. Put them on the job without the semblance of any political background."

In regard to soil erosion to which reference was made in the course of the discussion, Mr. Rockwood believed that by strip cultivation a certain amount of erosion could be avoided.

In regard to the implements which were being designed by a foreign expert, Mr. Rockwood said that once the investigations were over, all the implements should be turned out in this country.

Mr. Rockwood also stated that he hoped that the Rs. 6,000,000 which was received from the New Zealand Government would be utilised for the restoration of tanks and " not go down the drain ".

In regard to the question of growing citrus in the dry zone, Mr. Rockwood said that his experience was that citrus could not be grown in lowlying areas where there was water logging, nor could it be grown in areas where there was not sufficient water and moisture in the soil.

Senator C. Wijesinghe inquired about the co-operative method of farming adopted by the colonists, whether the produce is commuted in cash according to the number of labour units engaged by each family. He also inquired if out of five such farms, two had failed, whether the people who worked the latter would also benefit irrespective of the results of the crop.

Mr. Karunaratne replying to an earlier question by Mr. Rockwood, stated : " I might point out that regarding water requirements of dry zone crops, Mr. Rockwood made us understand that unless water is available from underground reserves it will not be possible to raise crops satisfactorily. The fundamental requirement here is that water has to be conserved in the catchment. At Relapanawa, the colonists and villagers had to go about five miles for water. It would surprise you that I had to dig eight wells, each well about 30 feet deep and I had 16 ft. of water. It was entirely due to the conservation of water in the catchment that this was possible.

In answer to the points raised by Senator C. Wijesinghe, Mr. Karunaratne stated: " In our dry farming schemes we have no absentee landlords. Every member of the Co-operative Society works on the farm.

Regarding the distribution of labour units and the value for their produce, all crops that are harvested are handed over to the Co-operative Society Stores. They are not expected to sell any produce outside. Crops once handed over are valued and it is divided according to the number of labour units put in by each family. In addition to this a two per cent. deduction is made as a reserve fund against famine, old-age, etc."

Referring to Senator Wijesinghe's question about the extent to which the colonists would be affected in the event of a failure of crops, Mr. Karunaratne said " Rainfall in the N.-C. P. is quite effective though once in about ten years we get a bad season. So far we have not come across any difficulty by way of a failure of crops."

Senator Wijesinghe: " Do they get a living wage?"

Mr. Karunaratne: " It would surprise you that after meeting all family requirements, most of these colonists have been investing their money on bicycles, gramophones, etc., so that their incomes are sufficient to keep them going.

Gate Mudaliyar Wickremaratne referring to the Chairman's introductory speech stated that it was not a case of dry farming but the desire to raise some economic crops in that part of the country. He added that the then Governor of the Island being desirous of developing that unused land and raising some crops, in this instance cotton, directed the then Director of the Royal Botanic Gardens (Dr. Willis) to make investigations. Dr. Willis accordingly selected Maha Illuppallama for the purpose. Cotton was grown

at Maha Illuppallama without success. Later on, during the time of Mr. F. A. Stockdale (later Sir Frank Stockdale) sun hemp was tried out at Maha Illuppallama which too was a failure and Maha Illuppallama was given up for a time. Gate Mudaliyar Wickremaratne continued: " I wrote to the Director of Agriculture to take up the question of dry cultivation to find out whether there are any chances of raising the production of food in this country. That was about ten months ago. Now I am glad that I heard at this meeting two of your officers who have been working at it have seen for themselves the results without depending on experts. As Mr. Rockwood said dry farming is quite different from raising crops in the dry areas. The question is whether we can raise crops for food purposes in the dry zone. New Zealand, Australia and America, they have their different soils and different climates. Even in India the soil is quite different to ours. Our soil in the N.-C. P. has been neglected for about 800 years. By that time the cultivated lands in other countries have been improved year after year and their soils are improved. But in the case of Jaffna, owing to the continuous cultivation of land with the addition of leaf and other matter to the soil, the Jaffna soil is quite soft and porus."

The other difficulty about dry farming is water logging as Mr. Abeyratne explained. I have always been impressed by the work done by people who lived in this country in the olden days. They built reservoirs and took water from rivers into reservoirs. From the reservoirs they sent down the water to smaller village tanks, so that these village tanks created a water table for the crops. Therefore to establish that water table in these dry areas, the same old system has to be adopted and we must not speak about dry farming in this country. Our country is placed in its natural setting with hills at the centre and plains all round. Therefore we have rivers right round like the Mahaweliganga which feeds an enormous area throughout its course. I read in the papers that Relapanawa area was cleared and that six tanks were found in that area. These tanks are watered from Kalawewa. If you can trace the irrigation officers who were present they will say how I have been going through that tracing in 1912. We have rivers all round and those rivers are getting silted. I felt very sorry when I heard that the Relapanawa area was being cleared. Why should we now think of dry farming? The only thing that we can encourage in dry farming is our pulses. But pulses can be grown as a rotation with other crops. We need not have a special dry area for that type of cultivation. What I say is, do not clear these forests unnecessarily. I suggested sometime back the method of preservation of water and how it should be done. At that time one of the European planters, Mr. Wilkinson, wrote to me that he has been in Ceylon for 50 years and that the present tendency was to make the Island a desert. You must all try and prevent it. When we have village tanks, why don't we utilise them. Therefore the only way to save this country and work for its progress is to restore all reservoirs, tanks and village tanks and give them to cultivators.

Regarding the question of encouraging sheep and goats and finding the land especially for goats, I fear that when we do not have sufficient land for paddy, we cannot have extensive areas for goats and sheep. We must go back to our old method of cultivation and not worry about dry farming. We must improve our tanks, village tanks and prevent our rivers getting silted, so that the people of this country will be benefitted."

Mr. S. Pathmanathan, Chairman, Low Country Products Association inquired whether the rental of Rs. 10 levied by Government from the Colonists was not too much?

Mr. Karunaratne: " The levy of Rs. 10 is not per month. Ten rupees is charged per acre, per year, on the cultivated extent of land. I do not think colonists find it difficult to pay this amount. Of course in cases of particularly bad lean years, we hope to recommend to the Minister to waive off the rental."

Mr. Keerthiratne said that before the dry farming programme was implemented in full, it was necessary to ascertain the areas that would be particularly suitable for crops and for stock farming. He inquired whether the Department had carried out investigations to ascertain these areas. He added that in the olden days for stock breeding, people utilised a part of the jungle and went on shifting the area gradually so that after about ten or fifteen years they came back to the same area. He added that the present conditions were quite different to what existed several years back, and that the present day conditions demanded not merely food for the people but also money for their other requirements. Clothing in the Vavuniya District sometime back was only a small piece of span cloth but under modern conditions even the vanni people find it necessary to clothe themselves fully. Therefore he said that it was essential to investigate first, besides their being able to procure their own food, whether the economic conditions of the colonists would be sufficient under modern conditions. It was therefore necessary, he added, to ascertain

whether crop husbandry or animal husbandry would be beneficial to the colonist from an economic point of view. He believed that it was best to encourage the breeding of Scindi animals because the conditions in the dry zone need acclimatised big made animals.

Mr. Keerthiratne also suggested that it was best to have an alternative scheme in case there was a failure of rains for a number of seasons, so that the people could at least take up to animal husbandry.

Referring to the hilly areas of the country which were abandoned, Mr. Keerthiratne inquired whether investigations have been carried out to ascertain if a variety of paddy suitable on hilly land could be found. He said that he knew of a hill paddy called Elwi which thrived well on hill tops. He also inquired whether the Department has been able to recommend to the people varieties of drought resistant crops. Mr. Keerthiratne emphatically stated that it was therefore very essential that the grant of Rs. 6,000,000 from New Zealand should be utilised in the best possible manner so that the country may be benefitted and requested that the grant should not be kept at the disposal of officers who were more inclined to spend the money on their travelling than to achieve something of benefit. He said that the money gifted by that country should be utilised to improve the agriculture and the economic condition of the dry zone peasant " as otherwise those areas would turn out to be the breeding ground of Leftists." He emphasised that as a democratic country, it was the duty of the Government to improve the living conditions of the peasant.

Mr. Keerthiratne referring to the Batticaloa area said that it was once a jungle and the people started growing coconuts. Now the coconuts were dying and the area was turning into a desert. He feared that the same thing would happen to the dry zone too if the problem was not tackled systematically.

He also condemned the practice of clearing jungle of all stumps and using bull-dozers on that land because he believed that the underground root system afforded sufficient means of retaining water and moisture in the soil. In conclusion he stressed the need for conserving underground water courses and building up the water table as practised by cultivators several hundred years back.

Mr. Henry Abeywickrema, M.P., inquired whether it was not a fact that the Government had decided to reduce the unit of acreage assigned to each colonist?

Mr. Karunaratne: " Hitherto the unit has been 5 acres of paddy and 3 acres of highland. That has been regarded excessive and the present proposal is to give 3 acres of paddy land and 1½ acres of highland in irrigation schemes. It cost the Government about Rs. 15,000 to establish a unit. Originally in 1921 when the Kurundankulama scheme was initiated it cost the Government about Rs. 4,000 to establish a unit but now it costs nearly Rs. 13 to 15,000 to establish a unit. The average income a colonist can get from his holding is about Rs. 750 to Rs. 2,000.

Mr. J. M. Sabaratnam: " According to figures it costs Government Rs. 15,000 to establish a unit whereas originally in 1921 when the Kurundankulama Scheme was initiated it cost the Government only about Rs. 4,000. The average income which a person receives from the land ranged from Rs. 270 to Rs. 2,000. The question is whether this could be considered as a reasonable return on an investment of Rs. 15,000 by the State. An average colonist's income if he had been engaged for work on a casual basis would amount to Rs. 900 if he had worked for 300 days per year. In view of this the net return on the investment is only a loss of Rs. 630 up to a profit of Rs. 1,100. The question of continuing this experiment should be therefore considered seriously by Government. Mr. Karunaratne mentioned that in the second experiment he had come across about six tanks in the area that was cleared for dry farming. We would like to know whether that water was used for any kind of irrigation or for purposes of the dry farming scheme. We would also like to know whether the scheme was successful because of the restoration of those tanks and whether the dry faming in that area would have been abandoned if such a water supply was not available? I am aware that dry farming is done in the Vavuniya District on a small scale, say on areas ranging from 2 to 5 acres, but the cultivator earns about Rs. 4,000 or Rs. 5,000 on that holding because a well is available on that land for his use. I think that the grant from New Zealand could be better utilised in finding sources of underground water so that wells could be constructed for Food Production purposes. If wells could be provided and water made available that would be the best attraction for any peasant to take up to cultivation without any further inducement. Recently there was a circular from the Director of Food Production restricting the subsidy for Food Production wells to new lands only. But I know that there are vast extents of previously cultivated land in the Jaffna and Vavuniya Districts which can be cultivated with success. If wells could be constructed and the cultivators are assured of the supply of water."

Mr. Karunaratne: "Regarding the question about the expenditure involved in establishing a unit in these colonization schemes, it costs us approximately Rs. 15,000 to settle a family. This compares very favourably with the irrigation scheme which spends Rs. 15,000 for establishing a unit of 8 acres, whereas we settle a family on 14 acres and the amount we spend is inclusive of the cost of barbed wire.

The second point raised was whether we utilised the water out of the 6 tanks that we came across this area. I have to say that not a drop of water from these tanks was utilised. My intention was not to utilise that water because it was not sufficient to cover more than a few acres. All the highland crops which are unirrigable were cultivated under rain-fed conditions. My idea was to utilise that water in the Yala for vegetable cultivation and to allow the crops to thrive with the October/November rains. But if the crops showed signs of distress towards December, the water could be utilised."

Mr. Sabaratnam: "Is it correct that the income from dry farming is only about 50 per cent. of what could be obtained by paddy cultivation?"

Mr. Karunaratne: "Paddy farming always pays. Originally the idea was to enforce a rotation and compel the colonists to cultivate crops according to the rotation. What we do now is to utilise boggy land for paddy cultivation."

Mr. N. M. Abulcassim Marikar: "I would like to ask a few questions, the first is—to how many districts has this dry farming scheme been extended?

There are a number of 'villus' (places where there are underground streams) which are eminently suitable for dry farming in the Mannar District. There are a series of 'villus'. In fact it was contemplated a couple of years ago that that area should be ideally suited for dry farming. These 'villus' are still available for investigation. May I ask whether you have taken into consideration all such places for purposes of your dry farming investigations?"

Mr. Abulcassim Marikar in conclusion said that he was very interested in the finding out of a high yielding strain of seed paddy for the dry zone areas of the Island. He said he was surprised at the headway made by the Department of Agriculture in their different Research Stations established in several parts of the Island. On behalf of the Board, he complimented the officers concerned for their good work and said that he was happy that local talent was available in the direction of research. He added: "The contribution made by the two officers is really interesting, instructive and very useful and I am sure that the progress will be very phenomenal if the services of such Research Officers were available to other parts of the Island too."

Mr. K. Kanagaratnam: "As you are aware, in Jaffna you have no rivers. There are small ponds. As far as my memory goes, for the last 50 years, the Jaffna farmer follows the same procedure. That is, his sowing time is somewhere in August or September and harvests the crop by about February, and then he sows gingelly seed. For this he entirely depends on rain water. If there is no rain, the crops fail. Therefore may I kindly ask whether any experiments had been organised by your Department with regard to Jaffna soils and whether any advice had been tendered to the Jaffna farmer as to how he could improve his methods of cultivation?

The other question is, I am very glad that your Agricultural Officers are carrying out experiments to devise improved implements to suit local conditions. Tractors are being used in the Jaffna District through the help of Co-operative Agricultural Unions. Even on small tracts of land ranging from $\frac{1}{4}$th to 1/8th acre, these tractors are used for ploughing.

In these two respects I will be very glad to know if any experiments had been hitherto carried out or whether any research will be done in the future so that you will help the poor Jaffna farmer?"

Chairman: "I may say that the Department has left Jaffna to its own resources because we find that in the Jaffna cultivator we have found a man who would deliver the goods in any case. But we realise that it is not entirely correct to leave him alone and I am very pleased to tell Mr. Kanagaratnam that from next month I am appointing a Research Officer to Jaffna for the sole purpose of investigation of dry cultivation in Jaffna." (Applause.)

Mr. Abulcassim Marikar: "What about the Mannar District, Sir?"

Chairman: "The officer appointed to Jaffna will look after Mannar also. We have six Research Officers, one of whom is for dry farming investigational work at Maha Illuppallama. We have also an officer there who is looking after paddy. We have one in the Eastern Province, one in the Southern Province, one in the Central Province and we are now appointing one to the Northern Province. He will give his attention not only to the Jaffna Peninsula but also to Mannar and Mullaitivu as well.

I must refer to one point. There was the question raised by Mr. Keerthiratne as to how we propose to spend the grant of Rs. 6,000,000 for the dry farming investigations at Maha Illuppallama. The programme and work have been very carefully planned. We have got an Experimental Committee to plan every detail and no expenditure will be incurred until every item is carefully gone into. As a matter of fact, the greater part of the expenditure is to be spent on buildings. About Rs. 4,000,000 will be spent on laboratories, buildings and quarters for officers. One cannot expect officers to go to outlying places like Maha Illuppallama unless quarters are given them. It is absolutely necessary that officers sent to these centres should have at least a modicum of facilities. Maha Illuppallama is not a sanatorium, nor is it a health resort. I would also like to emphasise this point that the money will be spent on research not only on crops, but also on animal husbandry."

Mr. A. M. Clement Dias: "I find we are spending Rs. 15,000 to produce food. If Rs. 15,000 can be spent on three parties to encourage poultry, each will produce 300 to 400 pullets. In 1950 I brought some birds from Europe. About 50 per cent. of them died but I reared the rest and today I am having about 400 birds and I have about 300 pullets." Mr. Dias emphatically stated that if in a place like Holland a hundred-thousand chicks could be produced a week, there was no reason why Ceylon should fail. He therefore suggested that instead of the Government spending Rs. 15,000 on each holding for a colonist, that money be utilised for distribution among three families who should be asked to take up to poultry farming.

Mr. R. T. Chelliah: "Some member in the course of discussion remarked that Jaffna is famous only for onions. I think it is useful to mention for the information of our friends, that Jaffna grows not only onions but even cabbage. Jaffna cultivator is trying to produce even carrots and beet-root and it will be a happy day to see when Jaffna is able to send cabbage, beet-root, &c., to Colombo."

Mr. Chelliah also thanked the Director for his promise of a Research Station at Tinnevelly. Mr. Chelliah mentioned that there were a number of neglected "villus" in Jaffna and if all those "villus" were cultivated, he emphasised, that he could assure the Board that Jaffna could live without coupons.

Mr. Chelliah also paid a compliment on behalf of the Board to Mr. M. Sivanathan, Assistant Director of Agriculture (Administration) and Secretary of the Board for the very efficient manner in which he had handled the work of the Central Board. He added that in his new appointment as A. G. A., Batticaloa, he would be able to make use of the knowledge he had gained in agriculture while being attached to the Agricultural Department. In conclusion he wished him all success in his new appointment, on behalf of the Board.

Mr. S. L. Bandara Dharmakirti stated that he had seen certain newspaper reports that potatoes had been grown very successfully by the Department in farms in the dry zone and whether more information could be had on the subject?

Mr. Karunaratne: "I really do not know how the papers could have reported that potatoe growing was made such a grand success. It was done on a very small scale and the yields were five fold."

Mr. S. M. Rasamanickam, M.P.: "I am very happy to be present here today and to have listened to the addresses of Mr. Abeyratne and Mr. Karunaratne. In fact I have visited Maha Illuppallama Farm myself and I was able to see some of the valuable experiments that are being carried out there. I should say that these Experimental Stations and these experiments on dry farming in this Island are very essential for the agricultural progress of this country. But I am particularly sorry to find that no mention was made as to how it is proposed to extend the scheme of dry farming to other parts of the Island, that is to other dry areas of the Island. In fact I have been interested to know whether this scheme would be extended to the Eastern Province and I have been disappointed.

I would like to make one or two observations in regard to tractor cultivation. Most of the ground has been covered by other speakers and I would like to know whether investigations have been carried out to find out the benefits and defects of tractor cultivation? Tractor cultivation has to be gone into more fully since tractor cultivation has become the policy in the Eastern province. I understand that the full tractor

strength in the Island is about 180, but I find nearly 80 tractors at work in the Eastern Province and most of the ploughing is done by tractors. Therefore what I want is a Research Station to be established in the Eastern Province and that some officer should go into this particular question. The other point I would stress is that these dry farming experiments be extended to other parts of the Island and to Batticaloa itself. Apart from recruiting the usual villagers who have had no knowledge of paddy cultivation, I suggest that young men irrespective of educational qualifications be recruited and sent out to settlements, if not to dry farming schemes, even to colonization schemes, particularly to the Gal Oya valley. I also suggest that the activities of the Karadian Aru Farm School be extended and that a minor Research Station be established at Karadian Aru for small scale investigations, especially on tractor cultivation."

Mr. Karunaratne : " Gentlemen, before we disperse I would like to clear one important conception. Dry farming does not mean raising arable crops only but it is diversified agriculture with livestock woven into the scheme.

In regard to poultry one gentleman said that instead of our spending Rs. 15,000 on settling people, that money could be utilised for promoting poultry development. In that same way, if each colonist is given a pair of bulls, a cow, and 5 hens, the settlement will own about 4,000 pullets in a year.

The other question raised was whether this dry farming scheme was not extended to other parts of the Island. This dry farming scheme is yet in its infancy and in course of time, depending on the results achieved, it is hoped to extend the scheme.

The other point I would like to clear is that irrigated farms should not be mixed up with dry farming. Even if you raise crops with underground resources, it is not dry farming. Then there was a point raised about the limiting of the acreage given under these colonization schemes. An area allotted under an irrigation scheme must be within the capacity of that tank or well. It is useless giving 10 acres of land, if the water available is not sufficient for that extent.

Regarding ' villus ' the only difficulty the Irrigation Department had come across was that it had to depend entirely on rain water, so that unless these ' villus ' were sufficiently deep, the evaporation rate is high."

Chairman : " Gentlemen, our late Minister of Agriculture, the present Prime Minister instructed that we should first concentrate in these two areas, learn all the difficulties inherent in the successful pursuance of the scheme and then proceed to other areas. In most of our Agricultural Stations there is a certain amount of investigation work carried out on dry farming methods. Even at Karadian Aru we have got a Research Officer stationed and while he concentrates his attention very largely on paddy he has also been asked to do a certain amount of work on dry crops. I thank all the gentlemen who contributed to the discussions on the subject of dry farming. I also thank these two officers (Messrs. C. R. Karunaratne and E. Abeyratne) on behalf of the Board for having given us the benefit of their experience. I think you will agree with me that the procedure adopted by us is very beneficial because you learn all that we have done or are doing on a subject and we learn from you all your experience and difficulties in regard to it."

Date of next Meeting

December 7th was agreed upon as the most convenient date for the next meeting.

Board's appreciation of the Services of the Secretary (Mr. M. Sivanathan, C.C.S.).

Chairman: " Gentlemen, the next point is a matter to which reference has already been made by Mr. Chelliah, that is the impending departure of our Secretary, Mr. Sivanathan, on promotion as A. G. A., Batticaloa. He has been Secretary of the Board for nearly two years and we are very grateful to him that during the time he has been with us he has given of his best and has been extremely helpful to us. Apart from his activities on this Board, I am extremely grateful to him for having given me valuable assistance particularly in the administration of this Department. On behalf of the Board I, therefore, express to him our grateful thanks for all the hard work he has put on matters connected with the Board.

Let me thank him on your behalf and wish him a very successful career. A great and bright future lies ahead of him."

The meeting terminated at 5.30 p.m.

M. SIVANATHAN,
Secretary,
Central Board of Agriculture.

Peradeniya, November 10, 1953.

Tea Research Institute

Minutes of Meeting of the Board of the Tea Research Institute of Ceylon held at the Offices of the Planters' Association of Ceylon, on Friday, October 30, 1953, at 2.30 p.m.

Present.—Mr. R. C. Scott, C.B.E. (Chairman), Messrs. C. Dymoke Green (Chairman, Agency Section, Planters' Association of Ceylon), W. R. Vander Kiste (Chairman, Planters' Association of Ceylon), W. H. Attfield, A. W. R. Joachim, M.B.E., V. G. W. Ratnayake, M.B.E., M.P., G. K. Newton, W. Neal de Alwis, M.P., Errol Jayawickreme, J.P., U.M., D. E. Hettiarachchi, J.P., U.M., A. D. McLeod, B. C. V. Weeks and J. Lamb (Director & Secretary).

1. The Notice convening the meeting was read

Messrs. H. S. Hurst and A. G. Ranasinha had intimated their inability to be present at the meeting.

2. Minutes of Board Meeting held on July 17, 1953

The Minutes of Meeting of the Board held on July 17, 1953, were confirmed subject to the inclusion of Mr. A. D. McLeod's name in the list of those present.

3. Membership of the Board and Committees

(*a*) *Board*

It was reported that:—

(i) Mr. V. G. W. Ratnayake, M.P., M.B.E., had been re-nominated by the Minister of Agriculture and Food as representative of the Small Holders for a further period of three years as from October 15, 1952.

(ii) Mr. H. S. Hurst had been re-nominated by the Planters' Association of Ceylon for a further period of three years as from April 21, 1953.

The Chairman expressed the Board's pleasure at their re-nomination and thanked Mr. B. C. V. Weeks for his services while he had acted for Mr. A. J. Dickson. Mr. Dickson had recently returned to the Island from leave but had not yet resumed his seat on the Board.

(*b*) *Estate and Experimental Sub-Committee*

It was reported that:—

(i) Messrs. S. P. Vythilingam and A. J. Dickson had resumed their seats on the above Committee on their return to the Island from long leave.

4. Minutes of the Meetings of the Estate and Experimental Sub-Committee held on July 11 and October 17, 1953

The Chairman reported that copies of the above minutes had been issued to members. He proposed that the Visiting Agent's report dated July 16, 1953, item 6 (*a*) on the agenda, be taken up for consideration along with the Minutes of the Sub-Committee. It had received the attention of the Sub-Committee at the latter meeting as would be noted from the Minutes.

In reply to a question raised by Mr. W. R. Vander Kiste, the Director (Mr. J. Lamb) gave details of the manna grass experiment which the Committee had agreed to terminate as it had proved unsuccessful.

5. Finance

(i) *Government Loan*

The Chairman informed the members that the final instalment of Rs. 75,315.66 against the Rs. 1,000,000 loan from Government had been paid on September 14. The loan was therefore now fully liquidated.

The Title Deeds of St. Coombs Estate, which have been in Government custody, as security against the loan, have been called for.

(ii) *T. R. I., Cess*

It was reported that receipts from cess for 1953 had, to the end of September, averaged Rs. 70,840 as against Rs. 72,100 for 1952. The total receipt to end of September was Rs. 637,000.

(iii) *Audit 1952 accounts*

The Chairman informed members that the audit of the 1952 accounts which had been delayed on account of Mr. Dias's absence on long medical leave had been completed on October 9. The audit report was now awaited and was expected in good time for the next meeting of the Board.

6. Small Holdings Advisory Service

The Chairman reported that:—

The Minutes of the Meeting of the Small Holdings Sub-Committee held on July 17 had been issued to members.

A further meeting of the Committee was held that morning when among other matters the estimates for 1954 were discussed. These would be circulated to members in time for the next meeting of the Board at which the estimates for 1954 would come up for consideration.

The balance lying to the credit of the Service at the moment was approximately Rs. 80,000. The Committee had recommended that for the time being as much as was considered feasible should be placed in Government Treasury Bills with a view to investment in the Government Loan which was likely to be floated in the near future.

Mr. V. G. W. Ratnayake proposed and Mr. B. C. V. Weeks seconded that the recommendation be implemented. Agreed.

The Director suggested that as the Institute had been making use of the funds, interest at the rate of 2½% should be credited to the Small Holdings Service account. Agreed.

He then gave details of the issues of tea seed and fertilizers during the year by the Service to Small Holders in the various provinces.

	Central Province	*Soutern Province*	*Province of Uva*	*Province of Sabaragamuwa*	*Total*
Tea seed (in maunds) ..	41 ..	28 ..	16½ ..	14 ..	99½
Manure (in tons) ..	105 ..	7·7 ..	9·7 ..	10·6 ..	141

Mr. de Alwis asked that these figures should be circulated amongst all Small Holdings Officers and Instructors.

7. Blister Blight

Contribution from Government.—The Chairman informed that the fourth and final instalment of Rs. 150,000 was received from the Tea Controller on September 5, 1953.

8. Any Other Business

(*a*) *Guest House Charges.*—The Chairman said that the charges for meals supplied to visitors at the St. Coombs Guest House were based on rates fixed at the inception of the Guest House. It had been pointed out that these rates were now out-of-date and required revision.

It was proposed that the rates be increased as follows:—

Breakfast	...	...	from Rs. 2/- to Rs. 2/50.
Lunch	...	...	from Rs. 2/50 to Rs. 3/50.
Afternoon tea	...	...	from Re. 1/- to Re. 1/25.
Dinner	...	...	from Rs. 2/50 to Rs. 3/50.
Hot Bath	...	...	from 25 cts. to 50 cts.

and that these charges notified in the "Tea Quarterly". Agreed.

(*b*) *Junior Staff Medical Fund.*—The Chairman informed members that a Memorandum dated October 15 had been received from the Junior Staff Association in which certain submissions had been made regarding medical benefits to the Junior Staff. The matter would be discussed by the Managing Committee of the Junior Staff Medical Fund and their findings put up to the Board for consideration at the next meeting.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle.

J. LAMB,
Secretary.

Rubber Research Institute

Draft Minutes of the 123rd Meeting of the Rubber Research Board held at the Planters' Association Headquarters, Colombo, at 2.30 p.m. on Monday, October 26, 1953

Present.—Mr. W. P. H. Dias, J.P. (in the Chair), Mr. W. Herbert de Silva, Mr. G. H. Dulling, Mr. R. J. Hartley, Dr. A. W. R. Joachim (Director of Agriculture), Gate Muhandiram Arthur D. S. Jayasinghe, Mr. L. J. de S. Seneviratne (Deputy Secretary to the Treasury), Senator C. F. W. Wickremasinghe, Dr. H. E. Young (Director, R. R. I. C.), and Mr. C. D. de Fonseka (Administrative Secretary).

1. Board

(*a*) *Death of Sir Chales E. Jones, C.M.G.*—Before commencing the business of the day the Chairman referred to the death of Sir Charles E. Jones, C.M.G., who had been a member of the Board some years ago. A vote of condolence was passed in the usual manner.

(*b*) *Senator C. F. W. Wickremasinghe.*—The Chairman reported that Senator C. F. W. Wickremasinghe had returned from leave and resumed membership with effect from 1st October, 1953.

2. Minutes

Draft minutes of the Special Meeting held on August 17 and of the ordinary meeting held on July 6, 1953, which had been circulated to members, were confirmed and signed by the Chairman.

3. Experimental Committee

Recommendations made at meeting of October 3, 1953:

(*a*) *Visiting Agent's Report.*—The following recommendations were approved:—

1. STAFF.—

(i) Appointment of an extra Assistant Clerk to the Estate Office in January, 1954.
(ii) Grant of a special increment to the Conductor-in-charge, Hedigalla Experimental Station.

(*a*) *Research Programme for 1954.*—This was approved and the Committee's recommendations regarding the appointment of additional staff and re-arrangement of existing staff were also approved.

(*b*) *Agency for Production of Local Clones.*—The recommendation that the arrangement whereby proprietary clones such as MK. 3/2, WG. 6278 and the NAB. clones are handled by the Institute on a royalty basis should be terminated was approved.

4. Reports and Accounts

(*a*) *Statement of Receipts and Payments for the Quarter ended June 30, 1953*, was approved.

(*b*) *Draft Estimates for 1954.*—Draft Estimates providing for income and expenditure for 1954 as follows were approved:—

	Rs.	*Rs.*
Estimated Income		1,327,446
Estimated Expenditure :		
Revenue	1,261,297	
Capital	572,148	
		1,833,445

Estimated excess of Expenditure over income 505,999.

(*c*) *Supplementary votes.*—Supplementary votes amounting to Rs. 6,231.87 were passed.

5. Staff

(*a*) *Director.*—It was reported that Dr. H. E. Young had returned from leave and resumed duties as Director on September 12. Mr. Van Emden was thanked for his services as Acting Director.

(*b*) *Acting Assistant Mycologist.*—It was reported that Mr. D. M. Fernando, Acting Assistant Mycologist, had returned after completing his course of training at McGill University, Canada, and had resumed duties on September 21, 1953.

(c) *Assistant Staff.*—The following changes in staff were reported:—

1. Appointment of Mr. H. L. Munasinghe as Laboratory Assistant (Myco Dept.) with effect from September 1, 1953.
2. Termination of services of Mr. B. D. de A. Gurusinghe, Rubber Instructor, with effect from September 30, 1953.
3. Transfer of Mr. R. B. Madawala, Rubber Instructor, to the Department of Agriculture for temporary work at its rubber nurseries with effect from August 1, 1953.

6. Contribution to London Advisory Committee and British Rubber Producers' Research Association

The proposed terms of re-organization of the London Advisory Committee and alignment with the B. R. P. R. A. were considered and agreed to.

7. Aerial Spraying of Rubber by Pest Control, Ltd.

Arrangements made in connection with the proposed trial of aerial spraying for Oidium control were reported and it was noted that a grant of Rs. 100,000 had been received from Government for this purpose.

8. London Advisory Committee

The following documents were tabled:—

(a) Annual Report for 1952.

(b) Draft minutes of meetings of the Committee, Technical Sub-Committee and Latex Sub-Committee held on May 8, March 26 and June 29, 1953, respectively.

9. Publications

The following publications were tabled:—

Advisory Circulars No. 37, 38 and 39.
Combined 3rd and 4th Quarterly Circulars for 1952.
Annual Report for 1952.

10. Minister's visit

The Chairman reported that the Hon'ble Mr. J. R. Jayewardene, Minister of Agriculture and Food, had visited Dartonfield and Hedigalla on October 24 and that he had expressed his pleasure at the work being done by the Institute.

The meeting then terminated with a vote of thanks to the Chair.

Dartonfield,
Agalawatta, January 20, 1954.

Administrative Secretary.

Draft Minutes of the 124th Meeting of the Rubber Research Board held at the Planters' Association Headquarters, Colombo, at 2.30 p.m. on Monday, December 21, 1953

Present.—Mr. W. P. H. Dias, J.P. (in the Chair), Mr. G. H. Dulling, Mr. W. Herbert de Silva, Mr. R. J. Hartley, Gate Muhandiram Arthur D. S. Jayasinghe, Mr. B. Mahadeva (Rubber Controller), Mr. L. J. de S. Seneviratne (Deputy Secretary to the Treasury), Dr. H. E. Young (Director) and Mr. C. D. de Fonseka (Administrative Secretary).

An apology for absence was received from Senator C. F. W. Wickremasinghe.

1. Board

(a) *Mr. E. W. Whitelaw.*—The Chairman referred to the death of Mr. E. W. Whitelaw, who had been a member of the Board for a number of years before his retirement from Ceylon and was at the time of his death the Chairman of the London Advisory Committee for Rubber Research (Ceylon and Malaya).

His death was a great loss to the Board and to the rubber industry in general. A vote of condolence was passed in the usual manner and it was noted that the condolences of the Board and the Staff had already been conveyed to the late Mr. Whitelaw's widow and family through the L. A. C.

(*b*) *Amendment to the Rubber Research Ordinance.*—The Chairman reported that the Ordinance had been amended to provide for inclusion of the Rubber Controller as an ex-officio member of the Board. He welcomed Mr. B. Mahadeva, Rubber Controller, who was present.

2. Minutes

(*a*) *Confirmation.*—Draft minutes of the meeting held on December 21, 1953, which had been circulated to members, were confirmed by the Chairman.

(*b*) *Matters arising from the Minutes.*—

1. *Research Assistant (Bot. Dept.).*—Reported that the Sub-Committee appointed at the last meeting had interviewed candidates for this post and offered the appointment to Mr. L. B. Chandrasekera, B.Sc. (Ceylon), who was expected to assume duties on January 2, 1954.

3. Reports and Accounts

(*a*) *Balance Sheet and Auditor-General's Report for 1952*, were approved.

(*b*) *Re-votes.*—Unspent balances of Capital Votes for 1952 amounting to Rs. 463,008.51 were re-voted for 1953.

(*c*) *Statement of Receipts and Payments for the 3rd Quarter, 1953*, was approved.

4. Staff

(*a*) *Mycologist.*—A letter from Mr. J. H. Van Emden, Mycologist, giving six months' notice of resignation with effect from December 7, 1953, was read.

(*b*) *Assistant Staff.*—

1. *Changes in Staff.*—The appointment of Mr. E. G. Mendis as Laboratory Assistant Myco Dept.), with effect from November 1, 1953, was reported.

2. *Loans for Purchase of Transport.*—Reported that loans of Rs. 1,950 and Rs. 1,500 respectively, had been granted to the Rubber Instructors of Talpe and Talangama for the purchase of motor cycles.

3. *Medical Certificates.*—It was agreed that Medical Certificates from registered and qualified medical practitioners may be accepted to cover sick leave when the officer concerned is too ill to go to a Government Medical Officer for a certificate. This decision is subject to revision later if found necessary.

5. London Advisory Committee

(*a*) *Ceylon Government Representative.*—It was reported that Mr. C. A. Meakin had been appointed as the Ceylon Government Representative on the London Advisory Committee in place of the late Mr. E. W. Whitelaw with effect from January 1, 1954. The Board concurred in this appointment.

(*b*) *Minutes of the 6th Meeting of the Executive Committee held on October 2, 1953*, were tabled.

6. Rubber Conference

Comments from members and others who attended the Conference on November 16 were read and it was noted that the Conference was generally considered to be a success. Possible improvements in arrangements for future Conferences were discussed.

7. Conference of Staff of Research Institutes in the Far East held at Bogor, Indonesia

A copy of the printed report on the proceedings of this Conference was tabled.

The Chairman wished members a happy Christmas and a prosperous New Year.

The meeting terminated with a vote of thanks to the Chair.

Dartonfield,
Agalawatta, January 19, 1954.

Administrative Secretary.

NOTIFICATIONS

Milk Board.

L. D—O. 54/49.

AN ACT TO PROVIDE FOR THE CONSTITUTION OF A BOARD TO ESTABLISH AND MAINTAIN FACILITIES AND SERVICES FOR THE EFFICIENT AND CHEAP PRODUCTION AND MARKETING OF MILK, TO PROMOTE THE ESTABLISHMENT AND MAINTENANCE OF SUCH FACILITIES AND SERVICES BY LOCAL AUTHORITIES AND OTHER BODIES AND PERSONS AND TO PROVIDE FOR MATTERS INCIDENTAL TO OR CONNECTED THEREWITH.

BE it enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the Senate and the House of Representatives of Ceylon in this present Parliament assembled, and by the authority of the same, as follows:—

Short title and date of operation.

1. This Act may be cited as the Milk Board Act, No. 12 of 1954, and shall come into operation on such date as the Minister may appoint by Order published in the *Gazette*.

PART I.

ESTABLISHMENT OF MILK BOARD.

Establishment of Milk Board.

2. (1) A Board to be called the Milk Board (in this Act referred to as "the Board") is hereby established for the purposes of this Act.

(2) The Board shall be a body corporate with perpetual succession and a common seal and may sue and be sued in its corporate name.

Common seal of the Board.

3. The common seal of the Board shall be officially and judicially noticed and shall be kept by such person and in such manner as the Board may from time to time determine. The seal shall not be used except by the authority of the Board and in the presence of at least two members thereof who shall sign the document to which the seal is affixed.

Constitution of Board.

4. (1) The Board shall consist of five members appointed by the Minister. The Minister shall appoint one of the members to be the Chairman of the Board.

(2) A person shall be disqualified for appointment as a member of the Board or for continuing as a member of the Board—

(*a*) if he is a Senator or a Member of Parliament; or

(*b*) if he has, directly or indirectly, any interest in a subsisting contract with, or in any work being done for, the Board except as a shareholder (other than a director) in an incorporated company consisting of more than twenty-five members.

(3) Where a member of the Board is a shareholder (other than a director) in an incorporated company referred to in sub-section (2) (*b*) which has entered into any contract with, or is doing any work for, the Board, he shall disclose to the Minister the nature and the extent of the shares held by him in such company.

(4) The Minister may, if he thinks it expedient to do so, remove, by Order published in the *Gazette*, any member of the Board from office without reason stated.

(5) Any member of the Board in respect of whom an Order under sub-section (4) is made by the Minister shall vacate his office on the date of the publication of such Order in the *Gazette*.

(6) Any member of the Board who has been removed from office shall not be eligible for re-appointment as a member of the Board or to serve the Board in any other capacity.

(7) If the Chairman or any member of the Board is temporarily unable to discharge the duties of his office on account of ill-health or absence from Ceylon or for any other cause, the Minister may appoint some other member to act in his place as Chairman or, as the case may be, may appoint some other person to act in his place as a member.

(8) Every member of the Board shall, unless he earlier vacates office by death, resignation or removal, hold office for a period of five years. Any such member who vacates office by effluxion of time shall be eligible for re-appointment.

(9) No act or proceeding of the Board shall be invalid by reason only of the existence of any vacancy among its members or any defect in the appointment of a member thereof.

Remuneration of members of the Board.

5. The members of the Board shall be remunerated in such manner and at such rates as may be determined by rules made under this Act.

Appointment of officers and servants.

6. (1) The Board may appoint such officers and servants as it considers necessary for the efficient discharge of its functions under this Act:

Provided that a person who is not a citizen of Ceylon, according to the law for the time being in force relating to citizenship of Ceylon, shall not be appointed an officer or servant of the Board without the prior sanction of the Minister.

(2) The officers and servants of the Board shall be remunerated in such manner and at such rates, and shall be subject to such conditions of service, as may be determined by rules made under this Act.

(3) The Board may, in accordance with rules made under this Act, establish and regulate a provident fund for the benefit of its officers and servants and make contributions to the fund out of the moneys of the Board.

(4) No person who has directly or indirectly, by himself or his partner or agent, any share or interest in any contract made by or on behalf of the Board shall become or remain an officer or servant of the Board.

Contracts.

7. Contracts on behalf of the Board may be made as follows:—

(*a*) a contract which if made between private persons would be by law required to be in writing, may be made on behalf of the Board in writing under the common seal of the Board;

(*b*) a contract which if made between private persons would be by law required to be in writing signed by the parties to be charged therewith, may be made on behalf of the Board in writing, signed by any person or persons duly authorised thereto by the Board; and

(*c*) a contract which if made between private persons would in law be valid although made by parol only and not reduced into writing, may be made by parol on behalf of the Board by any person duly authorised thereto by the Board.

Delegation of functions and powers of Board.

8. The Board may delegate any of its functions or any of its powers (other than the power to make rules or to appoint officers) to any member or officer of the Board, and may from time to time revoke any such delegation either wholly or in part and either as to persons or purposes; but every such member or officer shall, in the discharge of the functions or exercise of the powers delegated to him, conform to all such directions as are given by the Board. All acts done by any such member or officer, in conformity with such directions and in fulfilment of the purposes or his appointment, but not otherwise shall have the like force and effect as if done by the Board.

PART II.

Functions and Powers of the Board.

Functions of the Board.

9. (1) The functions of the Board shall be to establish and maintain efficient and cheap milk production and marketing services, and to promote the establishment and maintenance of such services by local authorities, and by other bodies and persons approved by the Minister, for the purpose of ensuring that an adequate supply of milk of good quality at reasonable prices is available to consumers of milk in Ceylon.

(2) For the purposes of this Act, milk production and marketing services mean facilities and services for the production and marketing of milk, including—

(*a*) dairies and dairy farms;

(*b*) the breeding, sale and purchase of livestock;

(*c*) the purchase, sale and distribution of milk;

(*d*) the grading, packing, storage, adaptation for sale, insurance and advertisement of milk;

(*e*) the purchase, storage, sale and distribution of forage;

(*f*) depots and establishments for the storage, sale, distribution and marketing of milk and forage;

(*g*) the acquisition and maintenance of all such livestock, land, buildings, plant, machinery, vehicles and other equipment as may be necessary for the purposes aforesaid; and

(*h*) all such other matters and things as may be ancillary to the matters or things referred to in the preceding paragraphs.

Power of Board to establish its own departments, etc.

10. The Board may establish its own departments or agencies for the purpose of the discharge of its functions and the exercise of its powers under this Act, or make contracts or other arrangements for such purpose with Government departments, local authorities or any person or body of persons.

Power of Board to sell property.

11. The Board may sell or otherwise dispose of any movable or immovable property belonging to the Board which in its opinion is not required for the proper discharge of its functions.

Assistance to local authorities and other bodies.

12. The Board may, subject to such conditions or restrictions as may be prescribed by rules made under this Act,—

(*a*) grant a loan to any local authority or to any other body or person approved by the Minister for the purpose of assisting such authority, body or person to defray the cost of establishing and maintaining milk production and marketing services;

(*b*) make a grant of money to such authority, body or person for the purpose aforesaid;

(*c*) sell or let for hire to such authority, body or person any plant, machinery, vehicles and other equipment required for the establishment or maintenance of such services; and

(*d*) make available, whether for fee or otherwise, to such authority, body or person any milk production and marketing services maintained by the Board.

Power to raise loans.

13. The Board may with the approval of the Minister given with the concurrence of the Minister of Finance, raise loans from the Government or any person or body of persons for the purpose of discharging its functions under this Act.

14. (1) The Board may make rules in respect of all or any of the following matters:— Power to make rules.

(*a*) any matter which is required to be prescribed;

(*b*) any matter which has to be determined under section 5 or sub-section (2) of section 6;

(*c*) the matters referred to in sub-section (3) of section 6, including in the case of a provident fund the contributions to be made thereto by officers and servants of the Board and the deduction of such contributions from the salaries of such officers and servants;

(*d*) the appointment, promotion, dismissal and disciplinary control of its officers and servants;

(*e*) the meetings of the Board and the quorum for, and the procedure to be followed at, such meetings.

(2) No rule made under sub-section (1) shall have effect until it has been approved by the Minister.

(3) The Minister shall not, without the concurrence of the Minister of Finance, approve of any rule made by the Board in respect of any matter referred to in paragraphs (*b*), (*c*) and (*d*) of sub-section (1).

PART III.

Finance and Accounts.

15. (1) The Board shall have its own Fund and a General Reserve. Fund and General Reserve of the Board.

(2) All moneys received by the Board, including such sums as may be voted by Parliament for use of the Board, shall be credited to the Fund, and all payments made by the Board shall be made therefrom.

(3) Save as otherwise provided in section 21, the amount standing to the credit of the General Reserve shall not be expended for any purpose except with the prior approval of the Minister.

16. (1) The Board shall cause its accounts to be kept in such form and in such manner as may be prescribed. Accounts of the Board.

(2) The books of account of the Board shall be kept at the head office of the Board.

(3) The Board shall cause its books to be balanced on the thirty-first day of December in each year and shall, as soon as practicable thereafter, cause to be prepared a profit and loss account and a balance sheet containing a summary of the assets and liabilities of the Board made up to date aforesaid. The profit and loss account and the balance sheet shall be signed by the Accountant and such other officer as may be named by the Board.

17. The Board shall have its accounts audited each year by an auditor appointed by the Permanent Secretary. The auditor shall receive such remuneration from the Fund of the Board as the Permanent Secretary may determine. Audit.

18. (1) The auditor shall examine the accounts of the Board, and ascertain the correctness of the Balance sheet and furnish a report stating— Auditor's report.

(*a*) whether he has or has not obtained all the information and explanations required by him; and

(*b*) whether the accounts referred to in the report are properly drawn up so as to exhibit a true and correct view of the Board's affairs.

(2) The report of the auditor shall be transmitted by him to the Board and a copy thereof shall be furnished by him to the Permanent Secretary.

(3) The Board shall, on receipt of the auditor's report in each year, transmit the report, together with the profit and loss account and the balance sheet to which the report relates, to the Minister who shall cause copies thereof to be laid before the Senate and the House of Representatives.

Receipts of Board.

19. A receipt signed by two members of the Board or by an officer expressly authorised by the Board to give receipts shall be an effectual discharge for moneys paid to the Board.

Application of profits.

20. The nett annual profits of the Board for each financial year may be applied to such purposes, including the payment of a bonus to members of the staff of the Board, as may be determined by the Board with the approval of the Minister given with the concurrence of the Minister of Finance; and all sums not so applied for any purpose shall be carried to the General Reserve.

Investment of General Reserve.

21. The amount standing to the credit of the General Reserve may be invested in securities of any description referred to in section 20 of the Trusts Ordinance; and the moneys realised from the sale of any such securities may be re-invested in securities of the like description.

PART IV.

MISCELLANEOUS.

Local authorities.

22. (1) The public services which any local authority is authorised to establish and maintain by or under any written law regulating its powers and duties shall be deemed to include milk production and marketing services; and the provisions of such written law shall be construed accordingly.

(2) The powers vested in any local authority by or under any written law regulating its powers and duties shall be deemed to include the power to make any contracts or other arrangements with the Board for the purpose of establishing and maintaining milk production and marketing services; and the provisions of such written law shall be construed accordingly.

Minister's directions to the Board.

23. In the discharge of its functions and the exercise of its powers the Board shall be subject to, and act in accordance with, such general or special directions as the Minister may issue from time to time.

Interpretation.

24. In this Act unless the context otherwise requires—

"Chairman" means the person appointed by or under this Act to be or to act as the Chairman of the Board;

"local authority" means any Municipal Council, Urban Council, Town Council or Village Committee;

"milk" means the milk of the cow or the buffalo, or any article manufactured or produced from such milk; and

"Permanent Secretary" means the Permanent Secretary to the Ministry in charge of the Minister.

RETURNS

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE ISLAND OF CEYLON—FOR QUARTER ENDING DECEMBER 31, 1953

Province	Disease	Fresh Cases during the Quarter	Total Number from the beginning of this Calendar year to the end of the fourth quarter				Balance ill at end of Quarter
			Cases	Deaths	Shot	Recoveries	
Western Province	Rabies	72	226	—	226	—	—
	Foot-and-mouth	—	2	1	—	1	—
	Tuberculosis	1	1	1	—	—	—
Colombo Municipality	Rabies	19	67	—	67	—	—
	Anthrax	—	1	1	—	—	—
	Tuberculosis	—	1	1	—	—	—
	Piroplasmosis	—	1	—	—	1	—
Quarantine Station	Anthrax	50	86	86	—	—	—
	Pleuro-Pneumonia	—	43	43	—	—	—
Northern Province	Rabies	—	1	—	1	—	—
	Foot-and-mouth	—	648	1	—	647	—
	Anthrax	72	357	357	—	—	—
	Black quarter	—	66	66	—	—	—
North-Central Province	Foot-and-mouth	—	318	3	—	315	—
	Rabies	1	6	—	6	—	—
North-Western Province	Rabies	6	7	—	7	—	—
	Foot-and-mouth	55	116	—	—	116	—
Central Province	Rabies	22	66	—	66	—	—
	Foot-and-mouth	54	271	—	—	271	—
	Anthrax	—	1	1	—	—	—
	Buffalo-pox	—	65	—	—	65	—
Province of Sabaragamuwa ..	Rabies	3	6	—	6	—	—
Province of Uva	Rabies	5	9	—	9	—	—
	Piroplasmosis	1	6	—	—	6	—
Eastern Province	Rabies	—	1	—	1	—	—
	Foot-and-mouth	71	—	—	—	61	10
	Black quarter	16	16	16	—	—	—
Southern Province ..	Rabies	8	19	—	19	—	—

Department of Agriculture,
Peradeniya, Ceylon,
January 22, 1954.

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

METEOROLOGICAL REPORT—SEPTEMBER, 1953

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Amparai	93·8	—	73·2	—	80	90	6·7	2·09	6	—
Anuradhapura	91·6	—0·2	74·5	—0·6	64	90	5·6	2·47	5	— 1·29
Badulla	85·7	0	63·9	—0·4	62	94	5·9	1·55	6	— 2·94
Batticaloa	89·9	+0·1	75·4	—0·8	73	88	4·4	2·40	3	+ 0·01
Colombo	85·4	0	77·1	+0·4	74	82	6·4	3·51	15	— 3·33
Diyatalawa	77·2	—0·6	59·9	—1·0	69	89	5·6	2·56	9	— 1·85
Galle	82·8	—0·1	77·7	—1·9	80	84	5·8	4·12	24	— 4·69
Hambantota	87·3	+0·7	76·6	+0·4	76	88	5·4	0·90	5	— 1·86
Jaffna	86·6	+0·3	80·0	+0·7	76	82	6·8	1·13	3	— 1·40
Kankesanturai	89·9	—	79·6	—	70	85	5·9	1·37	3	—
Kandy	82·7	—	68·3	—	70	90	5·9	2·74	12	—
Kurunegala	87·4	—0·2	74·6	+0·3	66	84	6·0	4·90	12	— 0·65
Maha Illuppallama ..	90·4	—	74·2	—	64	88	6·0	3·10	6	—
Mannar	88·0	+0·3	79·7	+0·9	78	87	6·4	2·26	2	+ 1·02
Nuwara Eliya	66·7	—0·1	54·1	+1·0	81	85	6·6	6·53	19	— 1·71
Puttalam	88·1	+1·3	77·8	—0·1	70	86	5·8	1·82	4	+ 0·24
Ratnapura	88·0	+0·8	73·2	—0·3	72	93	5·7	11·54	22	— 2·98
Ratmalana	86·1	—	78·5	—	71	80	6·3	3·34	16	— 3·34
Trincomalee	91·9	—0·2	76·9	—0·2	64	79	6·6	3·45	8	+ 0·02
Talawakele	72·1	—0·2	58·4	+0·1	85	94	6·5	8·12	22	— 1·63

WEATHER SUMMARY—SEPTEMBER, 1953

IN September again the rianfall was appreciably below normal in the south-western parts, the greater deficits, of the order of 5 to 10 inches or more, occurring scattered over this area. The greatest deficits were 13.41 inches at Theydon Bois Group, 10.58 inches at Hapugastenne Estate and 9.60 inches at Maliboda Estate. Outside the south-west quarter, the rainfall was above normal in places, the biggest excesses being only 4.50 inches at Alupolla Group and 3.44 inches at Stratheden Estate.

The greater monthly totals (those over 15 inches) occurred on the south-western slopes of the hills, where Norton Bridge recorded 21.30 inches for the month, Weweltalawa Estate 19.50 inches, Padupola 19.23 inches and Alupolla Group 19.03 inches. Outside this area the rainfall decreased gradually, monthly totals at the coastal stations being less than 5 inches. In the north and the east, the rainfall ranged generally from 2 to 5 inches, with smaller amounts here and there.

The weather during the month was mainly monsoonal, rainfall being confined chiefly to the south-western parts. During the period, 9th to 11th, on account of a trough of low pressure, fairly widespread rain was experienced, the rainfall being heaviest on the 10th, a number of stations in the south-western hill-country recording over 3 inches. At 9 stations the falls exceeded 5 inches, the highest being 7.02 inches at Norton Bridge and 6.83 inches at Arslena Estate. Many stations in the north and the east received rain only during this period. Some scattered evening thundershowers were experienced on the 16th and 17th.

Day temperatures were, on the whole, about normal, while night temperatures were above normal in the west and below normal in the east. The highest temperature recorded during the month was 96.2° at Batticaloa on the 4th, and the lowest temperature, 69.7° at Ratnapura on the 29th (for the low country)

and 47.3° at Nuwara Eliya on the 19th (for the whole Island). Humidity ranged generally from 65 to 80% by day and from 80 to 95% by night. Cloud amounts were above average and wind strength about average, the prevailing direction of wind being south-westerly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT—OCTOBER, 1953

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Amparai	89·9	—	73·7	—	—	93	7·3	7·78	21	—
Anuradhapura	88·5	—0·4	73·6	+0·1	78	93	7·0	17·35	21	+ 7·63
Badulla	81·9	—0·9	66·7	+1·2	78	95	6·8	12·52	25	+ 3·63
Batticaloa	85·8	—1·3	75·0	—0·3	80	95	5·7	7·87	23	+ 0·68
Colombo	84·9	—0·1	74·7	—0·1	77	88	7·1	25·62	27	+11·91
Diyatalawa	76·6	+0·3	60·9	+0·4	80	97	6·8	13·83	22	+ 4·65
Galle	82·8	—0·2	75·6	+0·2	81	88	6·6	18 83	29	+ 6·78
Hambantota	86·4	+0·2	75 6	+0·3	81	91	4·9	6·84	19	+ 2·08
Jaffna	85·6	—0·2	78·4	+0·8	82	89	6·6	10·53	17	+ 1·33
Kankesanturai	85·8	—	77·4	—	80	91	6·8	12·62	18	—
Kandy	83·6	—	68·6	—	75	92	6·8	17·86	23	—
Kurunegala	86·7	—0·6	73·4	+0·2	74	88	6·4	18·59	28	+ 3·73
Maha Illuppallama ..	87·8	—	73·4	—	74	93	6·9	15·76	20	—
Mannar	86·3	—0·6	77·9	+0·6	81	89	7·4	11·56	20	+ 4·98
Nuwara Eliya	68·8	+1·2	54·3	+2·4	84	91	6·9	7·17	26	— 2·59
Puttalam	86·4	+0·2	75·4	—0·2	78	93	6·8	10·96	23	+ 3·53
Ratnapura	87·7	+0·6	72·9	+0·1	80	93	6·6	27·77	27	+ 9·76
Ratmalana	85·6	—	76·3	—	75	86	6·7	19·65	26	+ 6·45
Trincomalee	87·2	—0·8	75·8	—0·2	77	88	6·9	8·10	23	— 1·45
Talawakele	73·4	+0·1	58·4	+0·7	86	97	6·2	10·29	26	+ 0·23

WEATHER SUMMARY—OCTOBER, 1953

THE weather during October was typical of the month. At the beginning there were evening thundershowers. From about the 3rd, on account of disturbances in the Arabian Sea and the Bay of Bengal, rainfall was experienced frequently, with cloudy skies and occasional thunder. The rainfall was heaviest in the south-western mid-country, where some stations experienced rain almost daily, with considerably heavy falls on the 9th, 20th and 25th. On the 25th there were about 40 daily falls exceeding 5 inches. These heavy rains resulted in local floods in the Western and North-Western Provinces. The wind was generally light. But, on a few days between the 19th and 30th, strong gusts were experienced during rainsqualls.

The greatest monthly totals were recorded at Gonapenigala Estate and Weweltalawa Estate with 53.30 and 41.51 inches respectively, while other stations with totals exceeding 35 inches were Halwatura Estate 39.61 inches, Pimbura 36.43 inches and Kumbaduwa Estate 35.17 inches. In the south-western low-country and in the southern parts of Kurunegala District the monthly totals exceeded 20 inches. There was a gradual decrease in rainfall towards the north and the east, the lowest totals (5-10 inches) occurring in parts of the Northern and Eastern Provinces and in the immediate lee of the hills.

The rainfall was above normal over a large portion of the Island, the excesses in the south-western mid-country being considerably high. The greatest excesses were 31.68 inches at Gonapenigala Estate

19.23 inches at Halwatura Estate, 18.97 inches at Newfoundland Estate and 18.90 inches at Kokkawita Group. There were comparatively high excesses (above 10 inches) in Kurunegala District, too. Deficits generally small, occurred among the central hills and in the northern parts to north of Trincomalee-Mannar, the biggest deficits being 10.44 inches at Hapugastenne Estate and 6.74 inches at Mullaittivu.

The number of daily falls over 5 inches exceeded 90, most of them occurring on the 9th, 20th or 25th. The highest were 11.10 inches at Gonapenigala Estate and 8.76 inches at Newfoundland Estate on the 25th.

Day temperatures were irregularly distributed on both sides of average, while night temperatures were mostly above average. The highest temperature recorded was 96.2° at Anuradhapura on the 2nd, and the lowest temperature, 70.4° at Maha Illuppallama on the 31st for the low-country, and 48.1° at Nuwara Eliya on the 9th for the whole Island. Humidity varied from 75 to 85% by day and from 85 to 95% by night. Skies were distinctly more cloudy. Winds were slightly below the average strength, the predominent direction being south-westerly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, NOVEMBER, 1953

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Anuradhapura ..	86·5	+0·7	69·4	—2·2	73	95	5·0	5 55	16	— 5·12
Badulla ..	79·6	+0·3	63·9	—1·6	73	94	5·8	9·11	12	— 1·14
Batticaloa ..	84·7	+0·5	73·0	—1·3	78	95	4·1	9·23	16	— 4·63
Colombo ..	85·7	+0·4	72·0	—1·4	69	85	3·8	15·08	12	+ 1·99
Diyatalawa ..	75·8	+1·7	58·1	—1·8	78	94	5·8	7·76	15	— 2·66
Galle ..	84·7	+1·1	73·4	—0·9	73	88	4·2	5·95	13	— 6·06
Hambantota ..	85·7	+0·3	73·5	—0·5	77	90	4·8	9·79	10	+ 2·22
Jaffna ..	85·2	+1·1	74·4	—0·4	73	86	6·2	10·37	15	— 6·90
Kankesanturai ..	84·3	—	75·4	—	76	84	5·9	13·86	16	—
Kandy ..	83·6	—	66·1	—	69	92	4·2	7·53	14	—
Kurunegala ..	87·2	+0·2	70·6	—1·3	66	90	4·6	5·02	10	— 7·37
Maha Illuppallama ..	85·6	—	70·1	—	73	93	5·6	6·97	14	—
Mannar ..	84·6	0	75·2	—0·4	74	86	6·0	7·63	12	— 2·56
Nuwara Eliya ..	70·0	+2·3	49·9	—1·3	74	84	4·6	6·16	10	— 3·03
Puttalam ..	86·5	+0·9	71·8	—1·4	72	93	4·4	5·44	14	— 4·69
Ratnapura ..	89·8	+2·2	70·9	—1·4	70	93	4·6	10·27	13	— 4·52
Ratmalana ..	87·3	—	74·2	—	64	84	4·2	12·37	13	+ 0·25
Talawakele ..	74·5	+1·0	55·3	—1·9	74	91	3·8	5·38	11	— 3·12
Trincomalee ..	83·6	0	74·7	—0·1	75	86	5·7	8·07	14	— 5·87

WEATHER SUMMARY—NOVEMBER, 1953

UNSETTLED weather in the Bay of Bengal was responsible for a week of settled weather over Ceylon during last month (3rd to 9th), with dry winds, no rain and cold nights. This is an unusual occurrence for November which is normally the rainiest month of the year. However, the cyclonic movement in the Bay of Bengal was so situated that, near Ceylon, winds were north-westerly, and on account of their previous passage over the arid plains of South India, they were devoid of moisture. Consequently, skies were clear and no rain was experienced over the whole Island, while nights were unusually cold with minimum

temperatures several degrees below average. A similar period of dry weather with cold nights occurred again between the 19th and 22nd.

From about the 13th north-east monsoon conditions were in evidence for a few days, when monsoon rain was experienced in the north and the east and evening thundershowers elsewhere. Rainfall was moderately heavy on the 13th, 14th, 16th and 17th. Fairly heavy widespread rain was experienced on the 28th too.

Over a major part of the Island monthly rainfall ranged from 5 to 10 inches only. Larger totals (10 to 15 inches or more) were found in the south-western low-country, among the eastern and south-eastern hills and in Jaffna District, the highest being 24.38 inches at Hendon Estate, 23.84 inches at Forest Hill Estate, 22.68 inches at St. Martin's (Upper) Estate and 22.13 inches at Udahena Estate.

Rainfall was below normal over most of the Island, bigger deficits (of the order of 5 to 10 inches) occurring on the south-western slopes of the hills and adjacent mid-country and in the north-eastern low-country. The biggest deficits were 12.85 inches at Aranayaka, 12.43 inches at Mayfair Estate, 12.4 inches at Polgahawela and 11.45 inches at Nedunkeni. Excesses, generally small, occurred scattered in places, mainly in the south-eastern parts, the only appreciable ones being 6.17 inches at Hambegamuwa and 5.20 inches at Tissamaharama.

There were 23 daily falls over 5 inches, most of which occurred between the 27th and 29th. The highest was 9.23 inches at Mawarella Estate on the 27th.

Temperatures were well above normal by day and well below normal by night. The highest temperature recorded was 92.9° at Ratnapura on the 11th and 27th, and the lowest, 60.4° at Anuradhapura on the 22nd for the low-country, and 37.3° at Nuwara Eliya on the 23rd for the whole Island. Humidity ranged generally from 65 to 75% by day and from 85 to 95% by night. Cloud amounts were below average. Winds were of average strength, the direction being variable.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, DECEMBER, 1953

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Anuradhapura	84·3	+1·1	69·2	—0·9	76	95	4·4	8·22	12	+ 0·70
Badulla	76·0	—0·6	65·1	+0·6	84	95	7·2	14·09	23	+ 2·86
Batticaloa	82·2	+0·3	73·4	—0·2	83	95	5·2	18·55	21	+ 1·56
Colombo	86·6	+1·1	72·6	+0·2	68	83	4·0	4·69	7	— 0·92
Diyatalawa	72·3	+0·3	59·2	+0·6	87	97	6·8	9·10	25	+ 1·03
Galle	84·1	+0·5	73·7	+0·3	77	90	4·8	10·05	15	+ 2·23
Hambantota	86·0	+1·4	73·7	+0·7	77	90	4·8	0·84	9	— 4·77
Jaffna	82·7	+0·2	74·0	+1·0	74	86	5·2	4·64	10	— 5·75
Kankesanturai	82·4	—	75·4	—	78	84	4·9	6·39	12	—
Kandy	82·3	—	66·0	—	71	89	4·6	4·54	15	—
Kurunegala	85·9	+0·1	70·4	—0·4	65	87	4·0	1·87	11	— 4·91
Maha Illuppallama ..	83·8	—	69·8	—	77	93	4·8	9·16	16	—
Mannar	82·9	+0·1	75·4	+0·6	76	84	4·8	4·33	13	— 3·46
Nuwara Eliya	69·2	+1·5	50·1	+1·2	82	90	5·2	6·44	15	— 1·37
Puttalam	85·6	+0·9	71·2	0	75	93	4·4	4·91	15	— 0·64
Ratnapura	89·1	+1·1	71·7	0	74	93	5·6	7·63	14	— 1·49
Ratmalana	87·8	—	73·7	—	67	86	4·2	7·59	6	+ 0·94
Talawakele	74·0	—0·4	57·1	—1·1	76	88	3·8	5·29	13	+ 0·11
Trincomalee	80·9	—0·2	76·0	+1·2	81	86	5 8	8·49	18	— 4·51

WEATHER SUMMARY—DECEMBER, 1953

THE rainfall in December was irregularly distributed on both sides of average, deficits predominating. The greater deficits (of the order of 5 to 10 inches) occurred in the Northern Province and in limited areas to north-west of the central hills, while the greater excesses (also of the order of 5 to 10 inches) occurred in the north-eastern hill country and to south of the hills. The greatest deficits were 11.76 inches at Nedunkeni, 8.86 inches at Jaffna Farm School and 7.97 inches at Rotawewa, and the greatest excesses 14.88 inches at Iddumekelle Estate, 12.68 inches at Keenakele Estate and 9.41 inches at Mawarella Estate.

Rainfall was heaviest on the north-eastern slopes of the hills, where several stations recorded totals over 25 inches, the highest being 43.31 inches at St. Martin's (Upper) Estate, 40.20 inches at Iddumekelle Estate, 39.97 inches at St. Martin's (Lower) Estate and 38.86 inches at Keenakele Estate. In the north-eastern low-country and over a major part of the south-western low and mid-country the monthly totals ranged from 10 to 20 inches. The rainfall was least in the neighbourhood of Kurunegala-Negombo, where the monthly totals were below 2 inches.

The weather during the month was generally of the north-east monsoon type. But the rainfall was mainly confined to the north-eastern hill country and the neighbouring low-country, so that the northern parts to north of Trincomalee received less than half the average for the month. The weather was slightly unsettled on a few days, viz.:—13th, 24th and 25th, on account of low pressure, when fairly heavy widespread rain was experienced. Dry weather prevailed during the period, 3rd to 8th, and on the 17th and 22nd.

There were 12 daily falls over five inches, the highest being 7.83 inches at Vaganeri on the 26th.

Temperatures were appreciably above normal, particularly by day. The highest temperature recorded was 92.0° at Ratnapura on the 2nd, and the lowest temperature, for the low-country 59.8° at Anuradhapura on the 4th, and for the whole Island 34.3° at Nuwara Eliya on the 8th and 23rd. Day humidity varied from 80 to 85% in the east, and from 65 to 75% in the west. Night humidity ranged generally from 85 to 95%. Cloud amounts were a little above normal. Wind strength was also a little above normal, the predominant direction being north-easterly.

D. T. E. DASSANAYAKE,
Director.

LIST OF NEW BOOKS ACQUIRED BY THE LIBRARY, DEPARTMENT OF AGRICULTURE, PERADENIYA

1. Good Land from Poor Soil—*E. R. Hewitt.*
2. How to Increase Plants—*A. C. Hottes.*
3. The Better Utilization of Milk—*R. C. Hutchinson.*
4. General Field Crops Laboratory Manual—*Leonard & Wood*, 3rd Edition.
5. Tree Crops—*J. R. Smith.*
6. Veterinary Pathology and Bacteriology—*Gaiger & Davies*, 3rd Edition.
7. Wild Animals in Captivity—*H. Hediger.* (Permanent issue to Veterinary Laboratory).
8. Genetics in the Twentieth Century—*L. C. Dunn.*
9. Aids to Histology—*G. H. Bourne*, 5th Edition. (Permanent issue to V. R. O.).
10. Practical Pathology—*Miller & Davidson*, 3rd Edition. (Permanent issue to V. R. O.).
11. Veterinary Obstetrics—*Benesch & Wright.* (Permanent issue to V. R. O.).
12. Practical Veterinary Pharmacology, Materia Medica and Therapeutics—*H. J. Milks*, 6th Edition. (Permanent issue to Veterinary Research Officer).
13. Market Gardening—*R. A. Robinson.*
14. Elementary Surveying—*J. Malcolm.*
15. The Methods of Statistics—*L. H. C. Tippett*, 4th Edition.
16. An Introduction to Population Genetics—*C. C. Li.*
17. Dairy Enterprises—*Field & McDowell*, Revised Edition.
18. Soil Science, its Principles and Practice—*W. W. Weir*, 2nd Edition.
19. Feeds and Feeding, Abridged—*F. B. Morrison*, 8th Edition.
20. Conserving Soil Resources—*Chapman, Fitch et al.* (Permanent issue to S. C. O.).
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